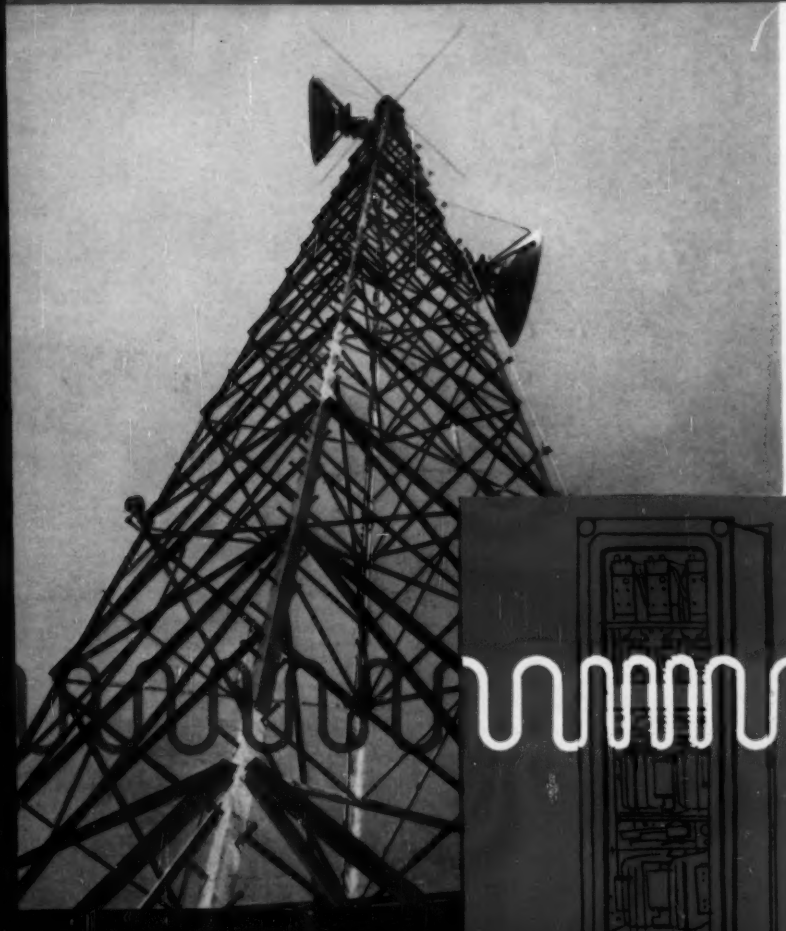
The Electrical Industry's Weekly Magazine

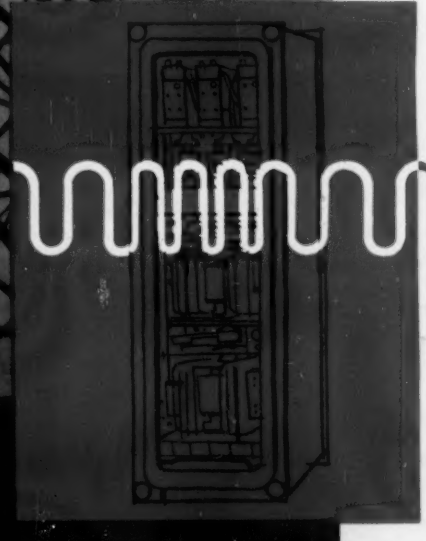
July 14, 1958

Electrical World

Price 50 Cents

A McGraw-Hill Publication





New Techniques in Relaying:

A Report on Microwave Transfer-Trip, Extended Range of Pilot Wire, and Protection for Tertiary Windings

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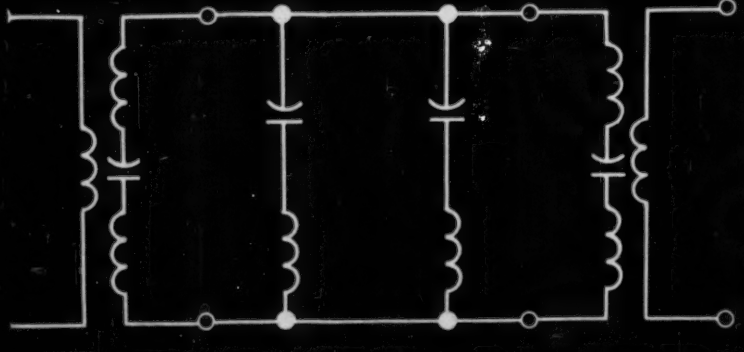

Distribution transformer "changeouts" are simplified by standardizing on unit sizes and ratings.

Preferred Design transformers with uniform mechanical features and accessories expedite substation planning and construction.

Repetitive manufacture of G-E standard-design medium transformers shortens delivery time, effects dollar savings for utilities. Also, simpler ordering procedures relieve electric utilities' engineers of time-consuming design and specification work.

OPERATION UPTURN spurs new interest in advantages of standardization

"extra values" inherent in standardized products take on new importance in present economic situation

General Electric's OPERATION UPTURN Program is designed to help accelerate the upturn in the nation's business by stressing "extra value" features of today's products. Electric utilities, for example, can obtain these extra values now, especially on standardized equipment. Major reason: the current economic situation re-emphasizes the importance of shorter shipments and savings to the user—traditional trademarks of standardized apparatus. Here are three examples:

MEDIUM TRANSFORMERS repetitive manufacture (RM) has brought 8% saving in price of these units—a saving to the industry of more than $20 million since 1943. In the next ten years, an additional $40 million can be saved if utilities step up the purchase rate of RM vs. "special" transformers.

POWER TRANSFORMERS incorporate "Preferred Design" components—features which utilities specified in a preference survey—so that improved transformers can be shipped 6 to 12 weeks faster, and also provide added economies through simplified substation and system planning. The PD Evaluation Form (GED-3400) outlines these benefits.

DISTRIBUTION TRANSFORMERS, standardized according to ratings and tank size, are stocked by more than 100 General Electric warehouses for extra-fast ordering and delivery. These allow electric utilities to safely slash their transformer inventories, reduce handling costs. "Changeouts" are also simplified since higher-rated units fit same mounting hardware and poles, in most cases, as lower-rated transformers being replaced. Result: important installation and maintenance savings for utilities.

To find out how the benefits of standardization are heightened by the current economic situation, contact your local G-E Apparatus Sales Office. General Electric Company, Section 301-389, Schenectady 5, New York.

MORE POWER TO AMERICA

GENERAL ELECTRIC

Electrical World

Vol. 150, No. 2 JULY 14, 1958

Published for 84 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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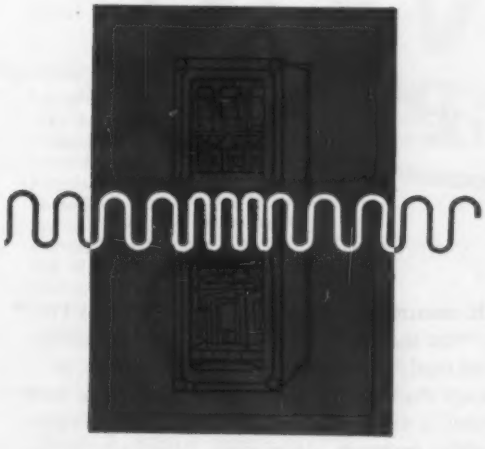

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In its first six months after announcement, the Lapp POC* Bushing has won the enthusiastic endorsement of utility engineers and equipment manufacturers from coast to coast. Rigorous characteristic and performance tests have been conducted in customer laboratories or in the Lapp laboratory under customer supervision. Practically every utility and every equipment manufacturer who have seen this bushing have placed it on Approved or Standards Lists—or tell us they are in process of approving it.

Lapp POC* is the bushing design of the future —ready to serve you reliably today.

Lapp Insulator Co., Inc., Le Roy, N. Y.

Quoddy's Value

I am glad that I have lived to see a true evaluation of the tidal project at Passamaquoddy Bay. In case you have not been informed, the piece of property, including 133 buildings and 142 acres of land, has been bought by a group of Boston businessmen for development into a resort for a total price of $250 thousand.

We have not investigated to find out whether the land includes the area in which the tidal plant would have been built, but we think that the price of the facilities is probably an over-evaluation of the economic wealth inherent in the Passamaquoddy scheme. When we think of the millions of dollars that have been poured into investigations of the feasibility of this tidal power project and the political implications of the whole idea, we get great pleasure out of reading about the final chapter in this non-sensical venture.

If there is one great lesson to learn from this government folly, it is perhaps that the true economic value of a power project should always rest or fall on its feasibility based on the development by a corporation which has to exist in a free economy.

Fischer Black

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ELECTRICAL WORLD

Vol. 150, No. 2 July 14, 1958

Published weekly by McGraw-Hill Publishing Co., Inc., James H. McGraw (1860-1948), Founder. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Printed at 99-129 North Broadway, Albany 1, N. Y. See panel at right for information regarding subscriptions or change of address.

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United States and Canada subscription rate for individuals in the field of the publication $6.00 per year; single copies 50 cents. Other Western Hemisphere and the Philippines $20.00 payable in advance and other countries $30.00 payable in advance.

Second-class mail privileges authorized at Albany, N. Y. Title registered in U. S. Patent Office.

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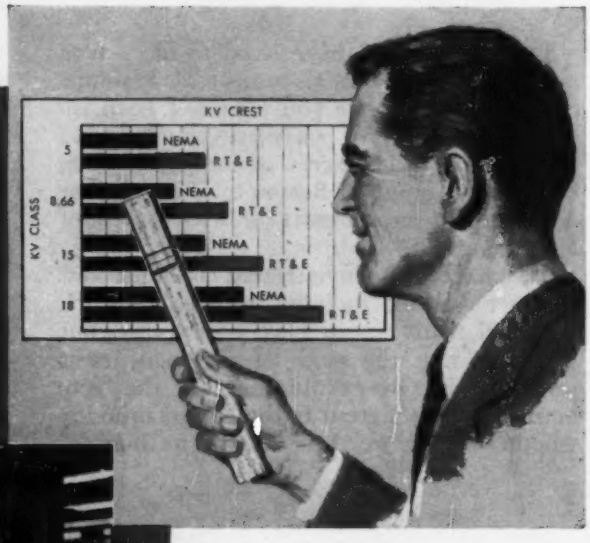
IMPULSE TESTED

DESIGN

High impulse strength in transformers is not obtained by accident, it must be considered from the very beginning of design. Such is the case at R T & E, where transformer design is based on impulse withstand levels approximately 50% in excess of NEMA standards.



TESTING

Every R T & E Transformer receives an "on the line impulse test" through use of the most modern equipment and methods known. This test not only insures that the transformer meets NEMA impulse level requirements but also rejects those transformers that are not of maximum quality.

OPERATION

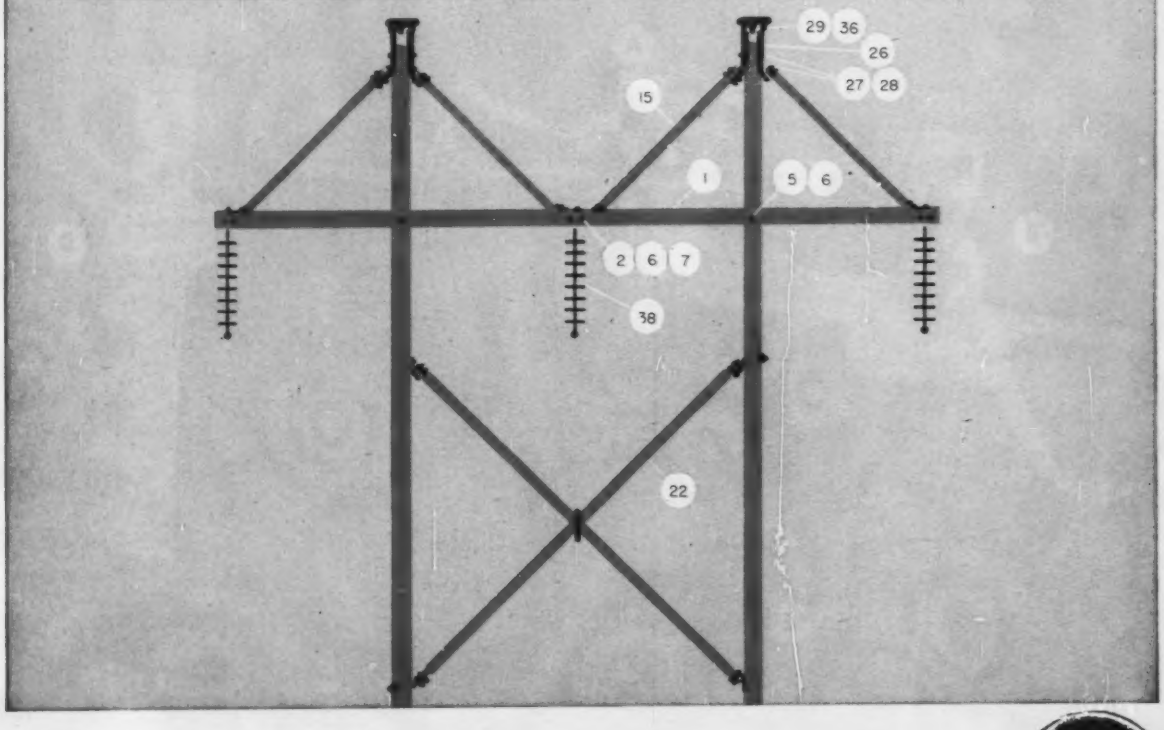
Naturally, the ultimate in testing is provided "on the system", where nature subjects the transformer to the most rigorous tests. R T & E Transformers have been thoroughly proven in operation in every climate of the U. S. They have been awarded the invisible seal of customer satisfaction, proved by a growing list of customers who specify R T & E.

R T & E CORPORATION
WAUKESHA, WISCONSIN
Helping PORTLAND, OREGON
Provide power for America

TANGENT W/BRACES NO. 702

H-FRAME STRUCTURE, DOUBLE PLANK CROSSARMS WITH METAL SPACERS, POLE TOP STATIC WIRE SUPPORTS, AND WOOD CROSS BRACES DESIGNED FOR 69 TO 154 KV CONSTRUCTION

DRG. REF. #	QUANTITY	DESCRIPTION	DRG. REF. #	QUANTITY	DESCRIPTION
792	2	Pole	15	4	Vee brace 3⅛" x 4⅛" cross section
1	2	Crossarm	22	1 set	Cross brace w/fittings, clamp, ⅞" pole bolts and curved washers
2	3	Steel spacer fitting w/mounting bolts	26	2	Static wire support
5	2	Stud bolt ⅞" w/washer nuts	27	4	Machine bolt ¾"
6	8	MF locknut ⅞"	28	4	MF locknut ¾"
7	1	Bent stud bolt ⅞" x 8" w/2 sq. nuts	29	2	Clevis
7	2	Bent bolt ⅞" x 5½" w/sq. nut	36	2	Suspension clamp for static wire
			38	As required	Suspension insulators and fittings



SIMPLIFY YOUR POLE LINE PROJECTS . . .

ORDER via Graybar

The combination of top quality materials and specialized Graybar service can make a substantial contribution to simplifying your pole line projects. For example, take the structure illustrated here.

These complete cross-arm units are fabricated and fitted with hardware according to *your* specifications. Every pre-bored member fits perfectly. You reduce time consumed and cost of field assembly. You can plan on a far more smoother, efficient operation and completing the job on schedule.

Need assistance in solving tough or unusual problems? In addition to our regular service, Graybar Outside Construction specialists and field representatives are always ready to share with you their specialized knowledge.

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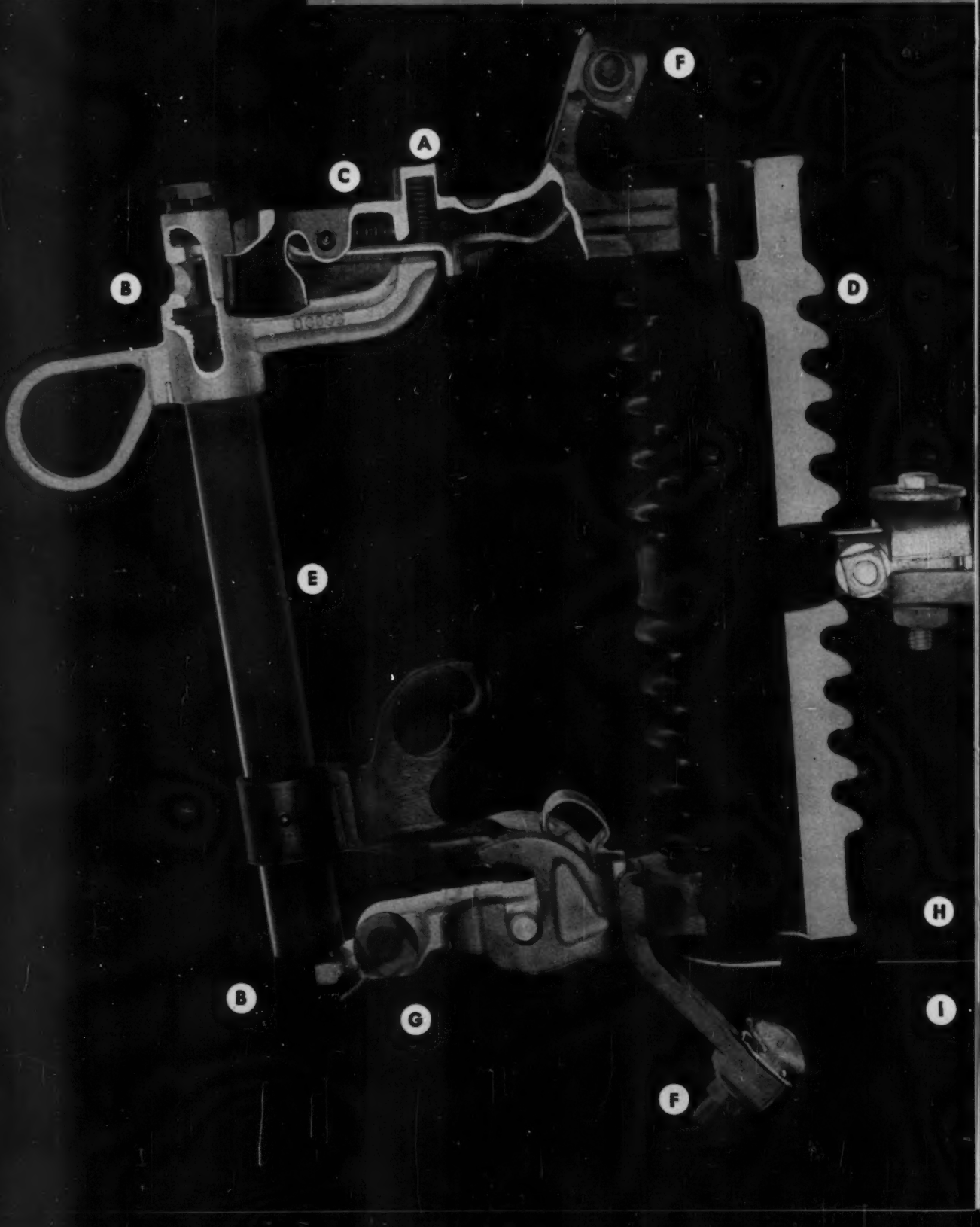

specify KEARNEY Type "G" Cutouts

Extensive, rugged, field operating tests prove that the Kearney Type "G" Cutout provides full protection throughout the complete range of fault currents—without use of adaptors or gadgets.

Study the advanced features that make these extra heavy duty cutouts your most logical choice for line fusing, transformer and capacitor protection.

Ask your Kearney representative to explain fully why you can count on Kearney Type "G" Cutouts for superior construction, thorough dependability and unfailing protection.

Check These Advanced Features

- **A** Full Floating Contact—stainless steel spring absorbs upward thrust, maintains contact pressure until arc is extinguished.
- **B** Gas Vents—double vent action minimizes internal gas pressure.
- **C** Horizontal Stainless Steel Spring—helps absorb recoil during fault interruption, takes shock when closing cartridge.
- **D** Insulator—designed for strength and lightness, barrier prevents internal leakage.
- **E** Cartridge—½" bore assures positive interruption of low faults; extra strength tube withstands pressure of high currents; accepts universal fuse links; no need for adaptors and other gadgets.
- **F** Terminals, Plated T-Lug Design—for use with all types of conductors.
- **G** Flipper—whip action provides 4" travel in separating blown fuse link.
- **H** All live parts non-ferrous or stainless steel.
- **I** Can be field or factory equipped with link break attachment.

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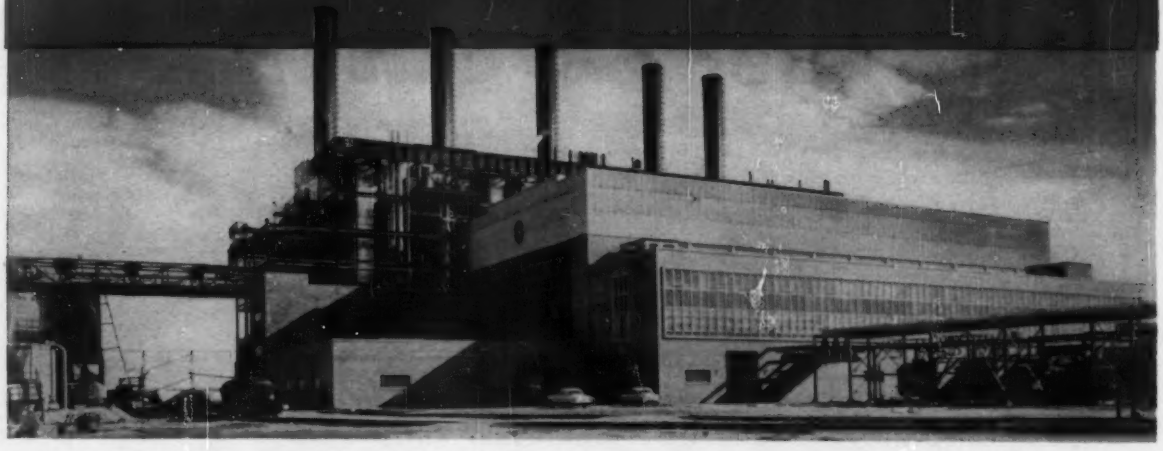
Specify Kearney Products

Plants at: **ST. LOUIS • FAYETTEVILLE, ARKANSAS • SHENANDOAH & CLARINDA, IOWA • GUELPH, ONTARIO, CANADA**

FIRST MAIN STEAM LINE OF TYPE 316 STAINLESS



Linden Generating Station of Public Service Electric and Gas Company of New Jersey, where the first main steam line of Type 316 has been in service, on Unit No. 2, since December, 1957.

One of Kellogg's Many Power Piping Firsts

Public Service Electric and Gas Company's Linden Generating Station is the first utility plant to use Type 316 stainless steel for a main steam line. Installed in Unit No. 2, with throttle conditions of 2350 psi and 1100 F, this alloy piping is 11⅝ in. O.D. x 1⅝₆ in. minimum wall thickness. The M. W. Kellogg Company fabricated this and other critical systems for this unit.

Kellogg's long list of "firsts" in power piping fabrication is due largely to its continuing studies in search for new alloys and new fabricating techniques which will permit industry to achieve still higher operating efficiencies. Kellogg is now working with Public Service of New Jersey on the main steam and other critical lines at Bergen and Mercer generating stations, utilizing austenitic and ferritic alloys.

Kellogg welcomes the opportunity to discuss its complete power piping design, fabrication, and erection facilities with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and auxiliary equipment.

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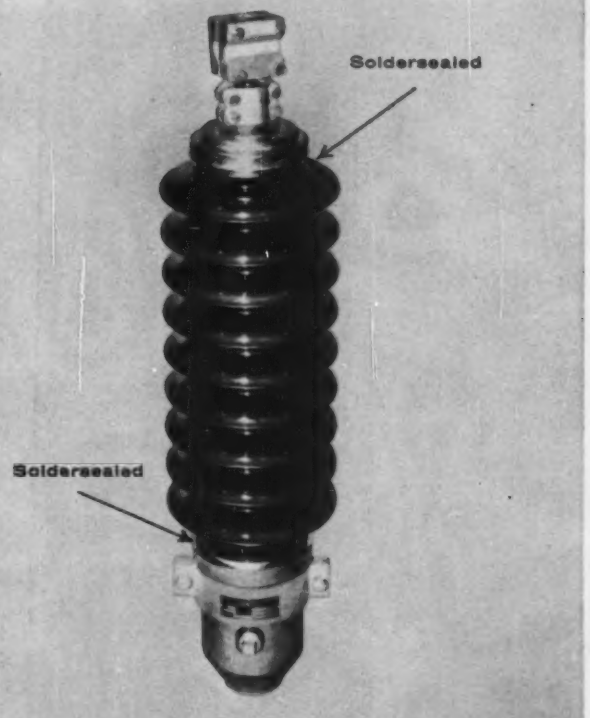
FIRST IN FABRICATION OF:

- Piping from C. ½% Mo.
- Station piping for 900 F.
- Station piping for 950 F.
- Station piping for 2200 psi.
- C. ½% Mo. piping with #3-#5 actual grain size
- 1¼% Cr.-½% Mo. steam piping
- Steam piping for 1000 F.
- ½% Cr.-½% Mo. station piping
- 2% Cr.-½% Mo. station piping
- Station piping for 1000 F.
- 2¼% Cr.-1% Mo. station piping
- 1¼% Cr.-½% Mo. station piping
- 1% Cr.-1% Mo. V. turbine piping
- 2¼% Cr.-1% Mo. V. station piping
- Station piping for 1050 F.
- 3% Cr.-1% Mo. station piping
- Type 347 stainless turbine piping
- Mercury vapor piping for 1000 F.
- Station piping for 1003 F. for France
- Type 347 stainless station piping
- Station piping for 1100 F.
- Type 316 stainless station piping
- Type 316 stainless station piping for 3500 psi-1050 F., 325 MW.
- Type 316 stainless station piping for 5600 psi-1200 F., 325 MW.

POWER PIPING—THE VITAL LINK

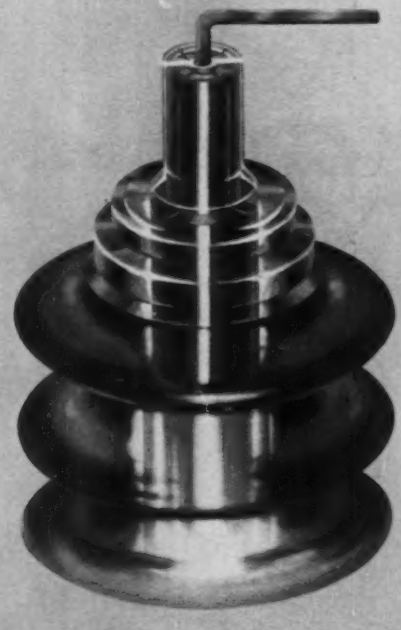
Why more and more utilities are adopting Anaconda Soldersealed Potheads

NO GASKET



TODAY'S TREND TO more severe load temperature cycles demands potheads of greater tightness and reliability than ever. That's one reason more and more utilities are standardizing on Anaconda Soldersealed Potheads. Leakproof Anaconda Soldersealed Potheads will stand these more severe load cycles—there are no gaskets to tighten . . . all connections are soldered . . . with the difficult seals between porcelain and copper fittings *made in the factory*—not in the field! No moisture can be sucked into the pothead during cool part of load cycles. Outages and maintenance costs are reduced. Installation is sure and easy. Illustration above shows Anaconda Soldersealed Pothead, 46-kv voltage rating.

UNIQUE DOUBLE ACTION CONNECTION



ANACONDA SOLDERSEALED POTHEADS are now made with an exclusive Double Action connection that eliminates the possibility of faulty field installation. This Double Action electrical connection is achieved by expanding the slotted stem against the inside of the copper hood and by the clamping action of aerial lug on the outside of the hood. Here's what else Anaconda's Double Action connection does: (1) prevents misalignment of cable during wiping and filling operation, (2) produces a permanent, sure electrical connection, (3) enables pothead to be easily dismantled and reinstalled, (4) eliminates possible damage to hood. Phantom drawing above shows how connection is made.

Anaconda Soldersealed Potheads are available in 1/C type up to 46 kv for indoor or outdoor service—stocked, ready for delivery. Write for Bulletin C-79-1330. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

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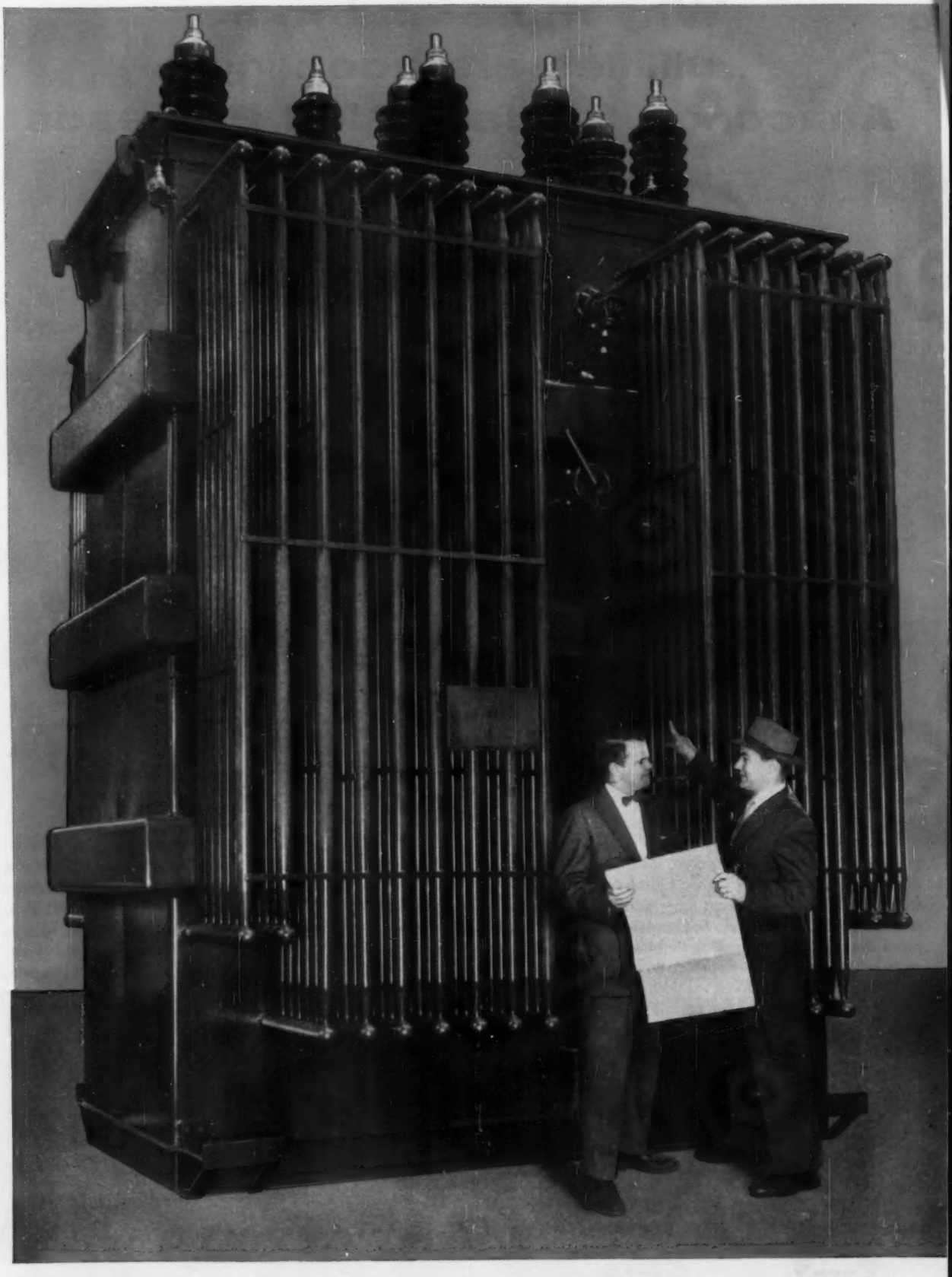
SEE THE MAN FROM **ANACONDA®**

FOR **SOLDERSEALED POTHEADS**



INTRODUCING THE NEW '58

KUHLMAN POWER TRANSFORMER

Kuhlman presents a new standard line of power transformers in all ASA ratings, 501 through 10,000 KVA, single or three phase 69 KV and below.

The new line, representing five years of planning and research, offers the latest developments in modern transformer design. Here are some of the features that will reduce maintenance, improve efficiency, and lengthen the life of your substations.

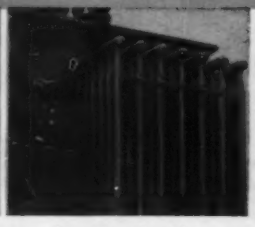
New Exterior Construction—features modern rectangular tanks, reinforced to give added strength—rounded, compact, cooling tubes for easier maintenance and maximum cooling in minimum space—sealed tanks to eliminate breathing, oil oxidation and moisture entrance.

New Interior Construction—features smaller core and coil units of greater efficiency—rigid mechanical bracing of leads with ample electrical clearances—extra protection around line leads and end coils—sturdy pressure studs and steel clamping rings for holding coils solidly in place.

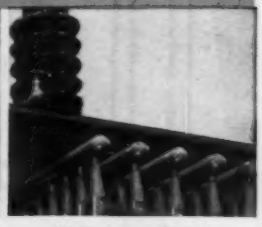
Also, stepped-back cruciform core for more compactness and freer oil circulation—self-aligning double-contact tap changer which locks in position—mechanically rigid core and coils braced to withstand vibrations and shocks in shipment and operation—strain-relief supports for tap leads.

More Standard Accessories—structural steel base to allow skidding in two directions with easily accessible jacking lugs; design permits tipping up to 15° with the tank empty or filled with oil—easy to read instruments with dark face dials and light color markings for better visibility—upper and lower filter press connections for filtering while transformer is in operation; lower connection also includes a sampling device—and many other convenient accessories. (Provisions for forced cooling and non-standard accessories are supplied on request.)

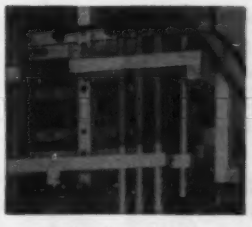
Heavy tank reinforcement



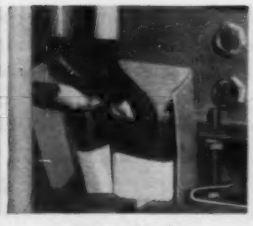
Compact cooling tubes



Welded covers (bolted covers supplied on request)

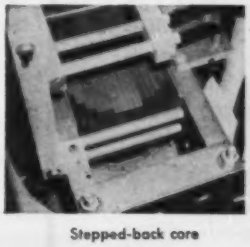


Rigid mechanical bracing



Protected leads

Pressure studs and clamping ring



Stepped-back core

Self-aligning tap changer

Supported tap leads

Skid base with jacking lugs

Easy to read instruments

Lower filter connection with sampling valve

Ask your Kuhlman representative about all the features offered on the new improved Kuhlman power transformer. He'll gladly discuss your requirements and show you how Kuhlman's standard designs now assure faster delivery—to any point in the country.

KUHLMAN POWER TRANSFORMERS

KUHLMAN ELECTRIC COMPANY General Offices: Birmingham, Michigan

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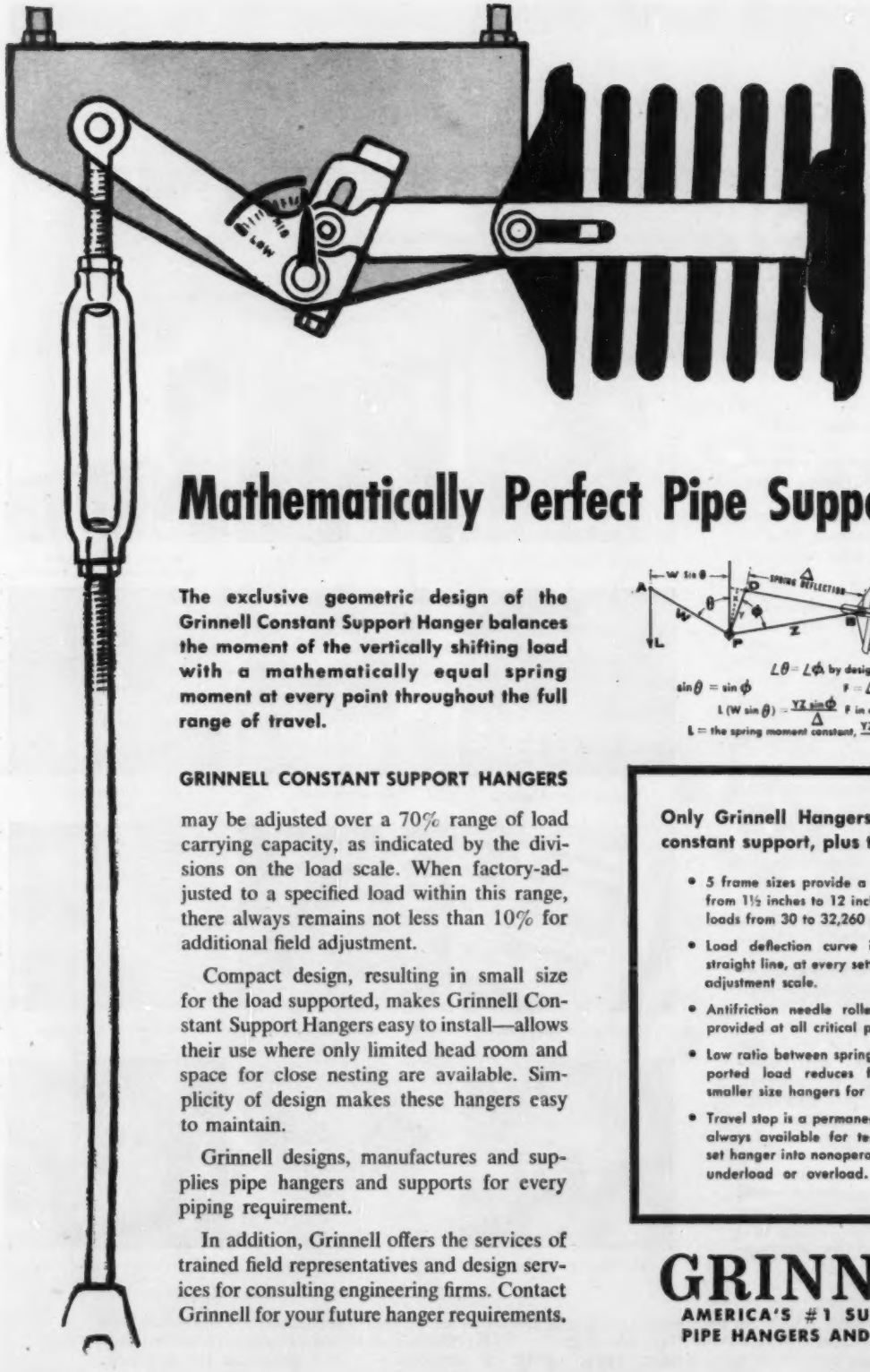
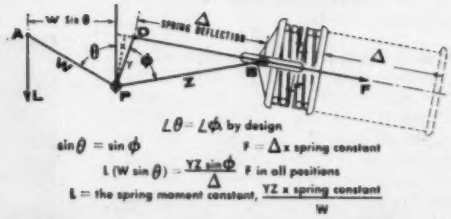


Mathematically Perfect Pipe Support!

The exclusive geometric design of the Grinnell Constant Support Hanger balances the moment of the vertically shifting load with a mathematically equal spring moment at every point throughout the full range of travel.



GRINNELL CONSTANT SUPPORT HANGERS

may be adjusted over a 70% range of load carrying capacity, as indicated by the divisions on the load scale. When factory-adjusted to a specified load within this range, there always remains not less than 10% for additional field adjustment.

Compact design, resulting in small size for the load supported, makes Grinnell Constant Support Hangers easy to install—allows their use where only limited head room and space for close nesting are available. Simplicity of design makes these hangers easy to maintain.

Grinnell designs, manufactures and supplies pipe hangers and supports for every piping requirement.

In addition, Grinnell offers the services of trained field representatives and design services for consulting engineering firms. Contact Grinnell for your future hanger requirements.

Only Grinnell Hangers provide true constant support, plus these features:

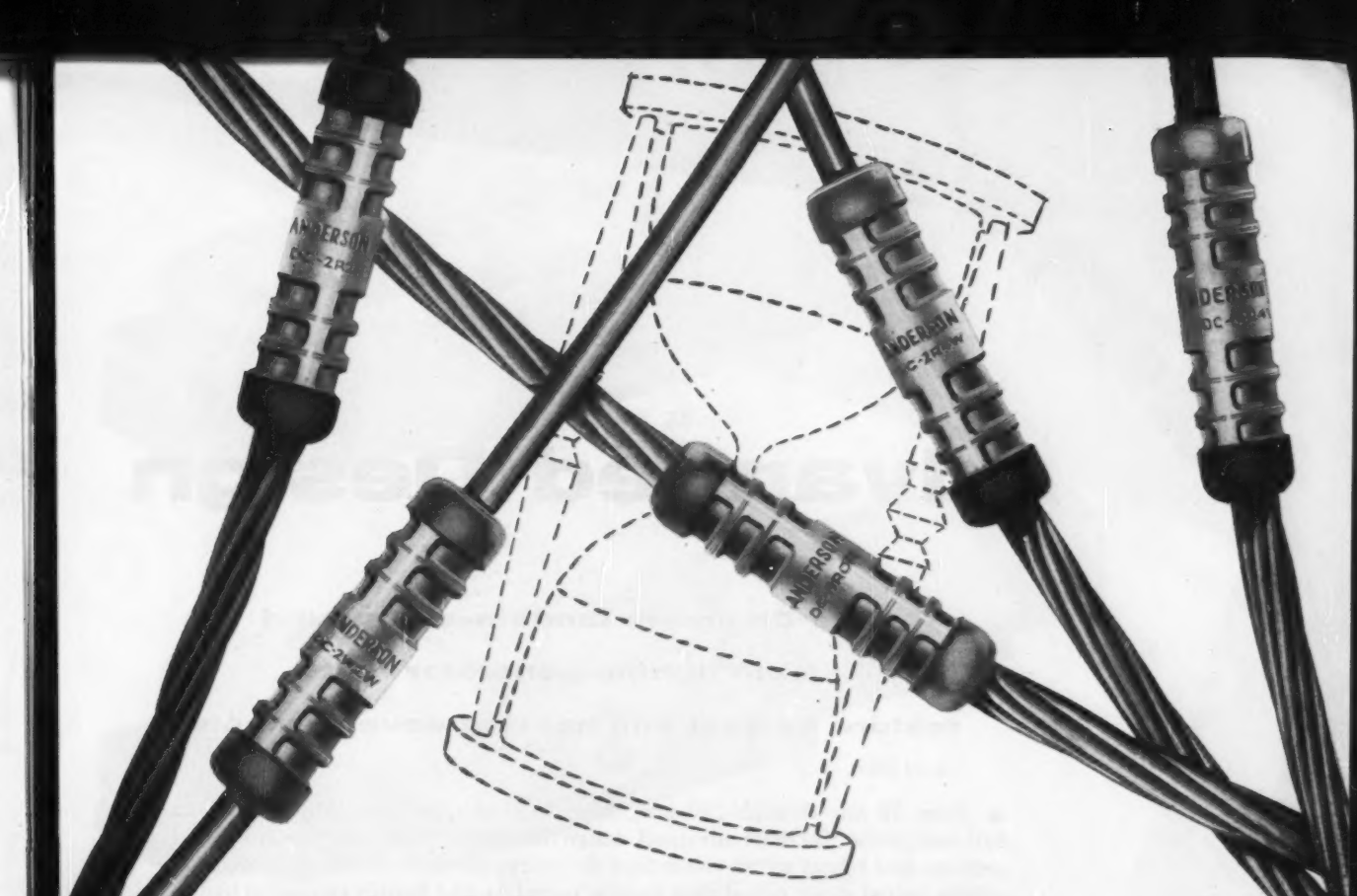
- 5 frame sizes provide a range of travel from 1½ inches to 12 inches and support loads from 30 to 32,260 pounds.
- Load deflection curve is a horizontal straight line, at every setting on the load adjustment scale.
- Antifriction needle roller bearings are provided at all critical pivot points.
- Low ratio between spring force and supported load reduces friction, permits smaller size hangers for loads carried.
- Travel stop is a permanent attachment — always available for temporary use to set hanger into nonoperative position for underload or overload.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



DURABLE

SERVICE ENTRANCE CONNECTIONS with ANDERSON DURA-CRIMP COMPRESSION SLEEVES

High conductivity! Quick, simple and easy installation!
Compact and neat! Wide range of conductor combinations!

Anderson Dura-Crimp Compression Sleeves are plainly marked to show (1) die size, (2) die press area, (3) catalog number and (4) complete cable size application. 5/8" O.D. line consists of 17 sizes to accommodate all combinations of Aluminum, ACSR and Copper conductors from #8 AWG to 1/0 AWG. 1/2" O.D. line, 14 sizes for all combinations of Aluminum, ACSR and Copper conductors from #8 AWG to #2 AWG.

Caps, color coded to indicate cable size, are easily removed or punctured by cable.

Anderson's exclusive inhibitor increases conductivity and pull-out strength. The inhibitor's correct distribution in both grooves is assured by a solid, built in center, which also insures correct cable length in each groove and prevents direct cable contact.

Contact your ANDERSON Representative for complete details . . . or write to our home office.

Aluminum & Bronze POWER CONNECTORS • CLAMPS • FITTINGS • ACCESSORIES
for SUBSTATION • TRANSMISSION • DISTRIBUTION

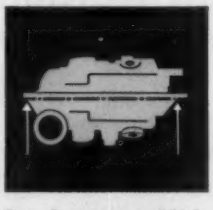
ANDERSON ELECTRIC
CORPORATION
BIRMINGHAM 1, ALABAMA

Advanced Design

Allis-Chalmers tandem-compound steam turbine-generator units feature newest engineering developments

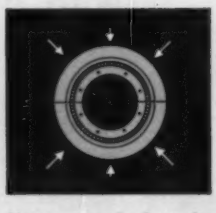
● From 75 mw through 250 mw, these 3600-rpm tandem-compound steam turbines utilize the most advanced design features, such as side-crossunders and primary and reheat steam valves that do not require removal during inspection, solidly bolted down non-sliding turbine pedestals, and flexibly supported hydrogen-cooled stator core.

Advances in design of double and triple-flow tandem ratings to 250 mw and of 3600/3600-rpm and 3600/1800-rpm close-coupled cross-compound arrangements to 300 mw and larger are revealed in publications 03R8620 and 03R8880. Call your A-C representative for copies, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

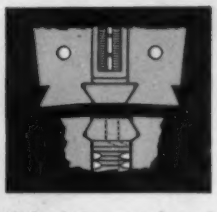


Centerline support of high-temperature turbine provides sustained concentricity of cylinder with spindle — offset parting joint adds rigidity to casing lower half without affecting the overall cylinder symmetry.

Side-mounted, underslung turning gear, for units with 23-inch exhaust blades and larger, engages shaft ring-gear below centerline — it need not be removed or electrically disconnected for unit servicing.



Ring-type nozzle chests, for 1000-1050-F inlet temperatures, are supported and keyed in inner casing, can expand freely, following spindle radial expansion. They also provide optimum nozzle orientation.

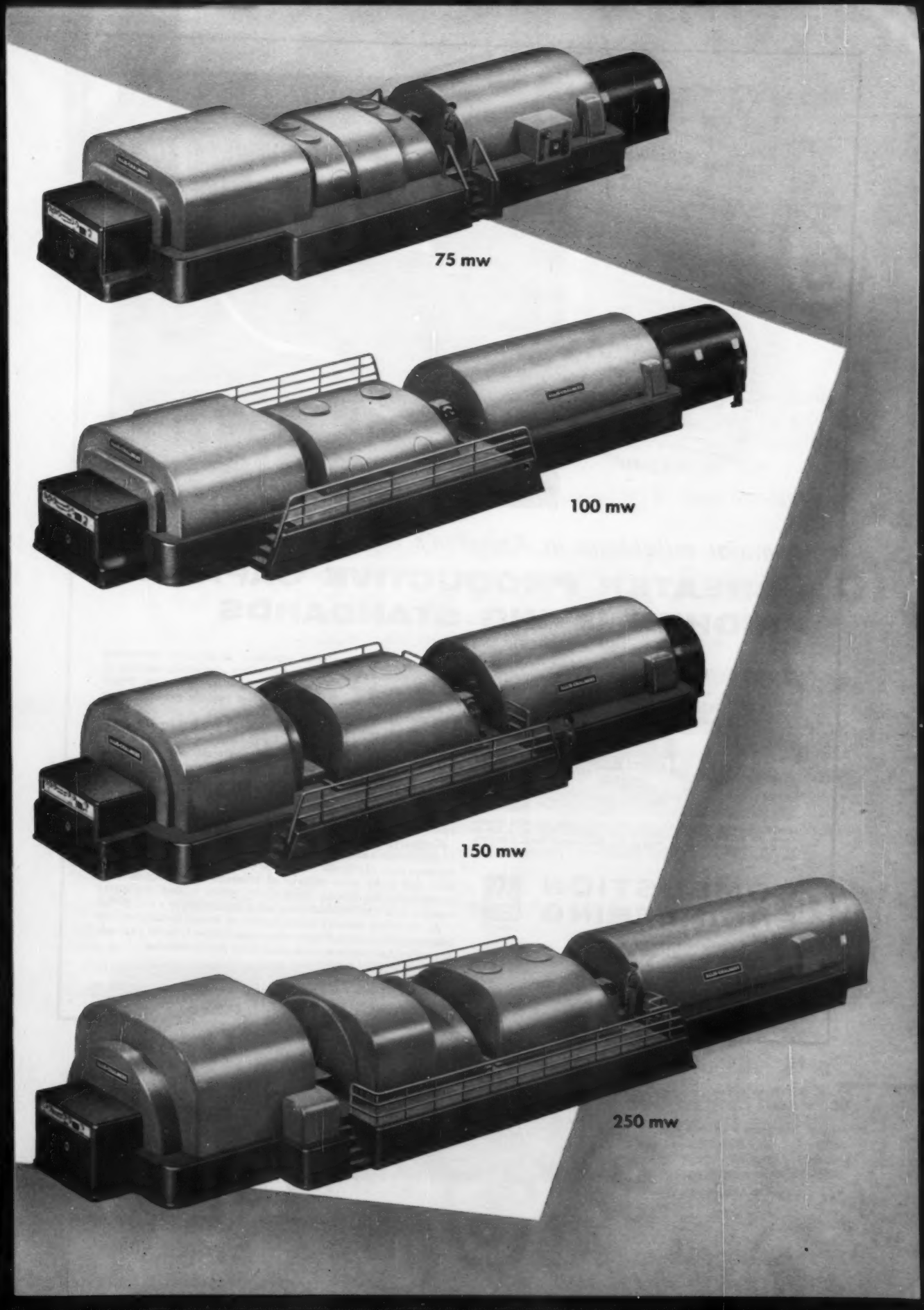


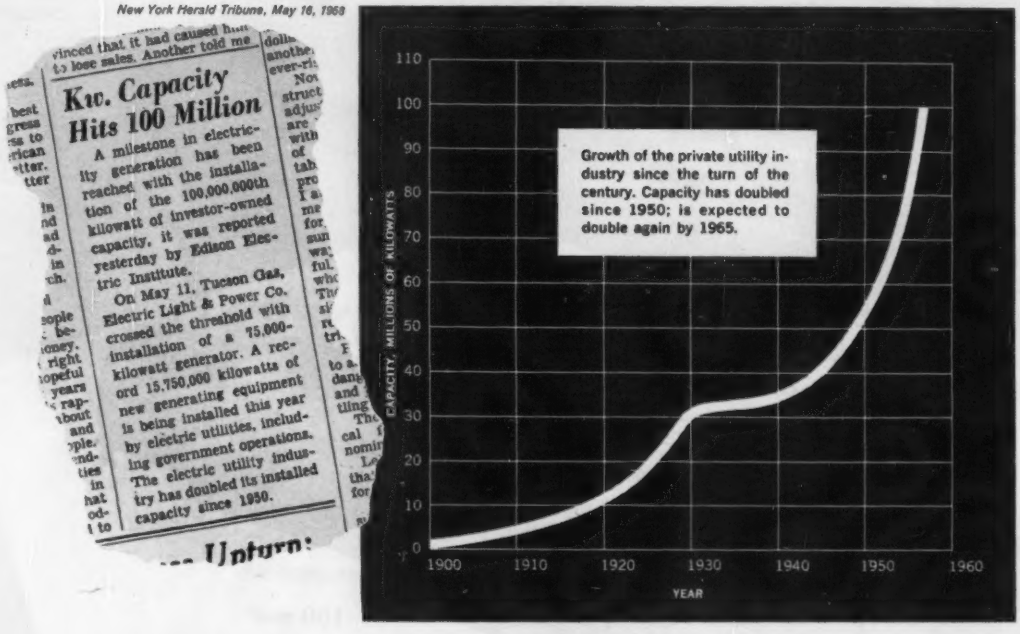
High-velocity supercharged hydrogen-cooling is employed in generator rotors for all 3600-rpm units over 50 mw—also in stators and their terminal conductors and bushings for units rated 150 mw and above.

A-C ALLIS-CHALMERS

A-5695

ALLIS-CHALMERS


75 mw
100 mw
150 mw
250 mw


New York Herald Tribune, May 16, 1958
Kw. Capacity Hits 100 Million
A milestone in electricity generation has been reached with the installation of the 100,000,000th kilowatt of investor-owned capacity, it was reported yesterday by Edison Electric Institute.
On May 11, Tucson Gas, Electric Light & Power Co. crossed the threshold with installation of a 75,000-kilowatt generator. A record 15,750,000 kilowatts of new generating equipment is being installed this year by electric utilities, including government operations. The electric utility industry has doubled its installed capacity since 1950.
Growth of the private utility industry since the turn of the century. Capacity has doubled since 1950; is expected to double again by 1965.
CAPACITY, MILLIONS OF KILOWATTS
YEAR
0
10
20
30
40
50
60
70
80
90
100
110
1900
1910
1920
1930
1940
1950
1960

A major milestone in America's march toward

• GREATER PRODUCTIVE CAPACITY
• HIGHER LIVING STANDARDS

POWERED BY A C-E BOILER, this is the plant that brought the utility industry across the 100,000,000-kw threshold. It's the 75,000-kw Plant No. 4, Tucson Gas, Electric Light & Power Co., Tucson, Ariz. (Sanderson & Porter, Consulting Engineers)

COMBUSTION ENGINEERING

C-E

J-161-A

Combustion Engineering Building
200 Madison Avenue, New York 16, N. Y.

Continuing their remarkable expansion of electrical generating capacity, America's investor-owned utility companies reached, in May, the significant landmark of 100,000,000 kilowatts. That's about double the capacity – privately and publicly owned – of any other country in the world.

Growth like this puts real meaning in the words "Live Better . . . Electrically." For example, it means the average American housewife today has the electrical equivalent of many servants helping her to do her housework . . . the average factory worker has the equivalent of 367 helpers. Thus, the utility industry, in its constant drive to provide *more power for more people*, has had perhaps the greatest single share of the job of assuring a steady rise in the standard of living in this country.

Combustion Engineering, too, has had a big part in this growth. In the past **ten years alone**, C-E Boiler installations have accounted for more than 25,000,000 kw of new capacity. Earlier C-E installations add many more millions of kilowatts to this figure. And, incidentally, the Tucson plant (left), which pushed the utility capacity over the 100,000,000-kw mark, is powered by a C-E Boiler.

As the utility industry heads toward its second hundred-million kilowatts, Combustion Engineering congratulates it for its vital role in making America ever more productive and prosperous.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

THE ABOVE ADVERTISEMENT, recognizing the achievements of the utility industry, appeared in recent issues of FORTUNE, BUSINESS WEEK and the WALL STREET JOURNAL. The combined circulation of these publications--well over a million--includes leaders in every area of business and government.

The Electrical Week

FUTURE NEWS ▶ **Look for NRECA General Manager Clyde Ellis to appear** on a popular national TV network interview show sometime this summer.

Joint Committee on Atomic Energy "hopes and believes" it can get together with AEC on a long-range program of power reactor development. Interpretation: Democrats are willing to meet prospective Chairman John McCone half way; but JCAE will submit its own plan to Congress if a pact doesn't materialize.

LATE NEWS ▶ **Utah Attorney General's Office rules laws on taxing co-ops** are invalid. It said laws violated a Utah constitutional requirement for a "uniform and equal rate of assessment and taxation." . . . Williamsburg, Va., City Council enacts a 5% tax on electric and gas bills.

AEC Director of Reactor Development W. K. Davis is resigning to join Bechtel Corp.

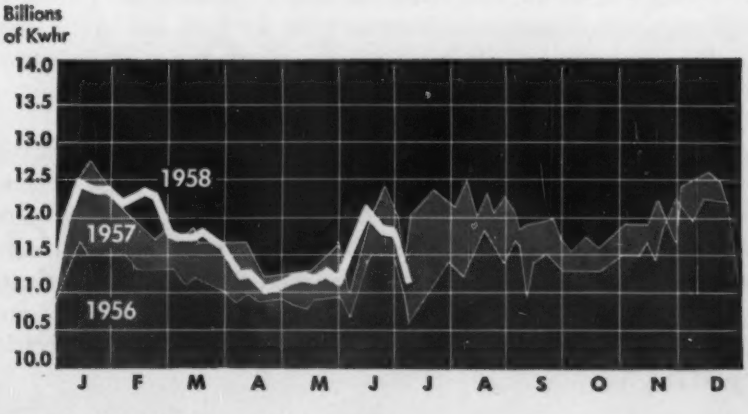
Nuclear energy will account for 20% of all power generation by '80, says National Planning Assn in a new study. Group's experts feel ¾ of power plants built from '75-'80 may be nuclear. They say A-power generating costs will drop to 6 mills by 1980. By that time a $10 billion capital investment will be involved.

Montana Power gets PSC approval to raise annual net revenues by $1,486,000 as against $1,824,481 requested.

Management changes . . . West Penn Electric: C. B. Finch, H. D. McDowell, and E. W. Wilkinson to vp's, and F. J. McAlary to assistant vp . . . Southern Co: R. Wardle, Jr, to vp . . . Magic Valley Electric Cooperative (Mercedes, Tex.): G. King, Jr, to manager.

Obituaries . . . Walter B. Morton, chief electrical engineer, Pennsylvania P&L and John Donahue, Hartford Electric Light vp.

POWER OUTPUT—Up 0.9% (Week ending July 5), Kwhr 11,150,000,000 (est.)



Per Cent Change From Previous Year

	June 21	June 28	July 5
Total U.S. ...	−3.2	−2.9	+0.9
New Eng.	−4.4	−3.9	*
Mid. Atlantic ..	−10.5	−7.8	*
Cent. Ind.	−6.7	−3.9	*
West Cent.	+0.3	+1.0	*
Southeast	−2.4	−3.1	*
South Cent.	+12.5	+6.4	*
Rocky Mount. ..	+5.1	+4.6	*
Pacific			
NW	−11.9	−11.8	*
SW	+2.1	+0.1	*

Seasonally Adjusted Index 228.7
Week Ago 220.3 Year Ago 228.1

Atomic Energy Commission requirements—1,050,000,000 Kwhr (Electrical World Estimate). Excluding AEC, Output increase was 0.8%.

*Not available due to holiday.

EVENTS ▶ **A hot spot is developing** as private utilities around Utah begin talk of a congressional review. It came about when Moon Lake Electric Association, Utah, got a $4.2 million REA loan to construct a 35-mi, 115-kv line to Flaming Gorge Dam site plus installation of another 14,000 kw of diesel generating capacity. The co-op, under contract, will supply 7,000 kw for construction at Flaming Gorge, but lacks the necessary capacity to do so without adding to its generating facilities. The question is, what will Moon Lake do with this excess capacity when Flaming Gorge is completed? **(p 46).**

Informal complaint has been filed by Northwest Public Power Association, asking FPC to halt joint construction by Idaho Power Co and Washington Water Power Co, of a 230-kv line from Idaho Power's Brownlee dam to Lewiston, Idaho **(p 48).**

SPECIAL REPORT:

RELAYING ▶ **New relaying techniques must be found** in order to cope with the complex problems of system expansion. Today, relay engineers are developing these techniques, as revealed by the Special Report in this issue. Two of its articles involve use of microwave to handle relaying of multi-terminal lines. The third describes a means of extending the operating range of pilot-wire protection, while the last sets forth an inexpensive method of protecting the tertiary winding of an autotransformer **(p 49).**

GENERATION ▶ **Problems of boiler feed pump installation are simplified** when cooling air is discharged vertically, providing better ventilation and reducing space requirements . . . Aluminum lagging covers insulation on two new outdoor boilers. Savings on painting and maintenance costs are expected to justify the increased investment **(p 62).**

MANAGEMENT ▶ **A record first half** for electric utility financing closed with a rush as $309 million in offerings flooded the June market. The onrush carried total new money financing by electric companies to a record high of $1.54 billion for a six month period, but left dealers shelves clogged with over $100 million in high grade securities to be sold. About 60% of the electric utilities' '58 financing has been completed, with estimates of second half totals running $1.06 billion. It looks as though big moves in bond yields are over for the year, and in the long run will hinge on an upturn in capital expenditures, not likely before next spring **(p 103).**

SELLING ▶ **An electric grain dryer has been developed for small farm use; selling** for $500, unit pays for itself in three to five years . . . The electric housewares industry plans a "Give Better Electrically" sales promotion for Christmas '58. It will be backed by largest single ad ever placed in a consumer magazine by one advertiser . . . Basic illuminating principles as well as recent developments in the lighting field are covered in an eight lesson course available from Sylvania Electric Co **(p 111).**

NEW PRODUCTS ▶ **Bushing-type CT's are now available** for Kyle type R or W reclosers; compact and weatherproof, they are for external installation . . . Dielectric test sets with ratings from 20 to 350 kv and 2 to 1,000 kva are now available. Equipment is designed to meet ASTM methods of testing . . . New preformed accessories for Kaiser Triplex AC and Reynolds 5005 aluminum alloy conductors include armor rods, line splices, dead ends, and patch rods, all of high-strength aluminum alloy **(p 88).**

INDUSTRIAL ▶ **An automated paint spray line pays off** for a Pennsylvania firm, producing a better finish in less time with fewer rejects . . . Photoelectric scanners automatically detect broken threads in knitted fabrics as they move off the line; in event of thread failure high speed knitting machines come to halt before two inches of cloth has been produced **(p 112).**

MANUFACTURERS ▶ **Newcomer in the protective relay field** is Federal Pacific Electric Co; its new line utilizes only three basic movements, is presently in pilot plant production . . . Allis-Chalmers has developed an instrument potential transformer of 230-kv capacity; the corona-free, hermetically sealed device weighs 60% less than conventional units of similar capacity . . . A half-mile 250-kv dc submarine power cable has been laid seaward from Oteranga Bay, New Zealand. This trial cable will be used to gather data for future transmission installations in the area **(p 76).**

A $1 million high voltage lab for testing switchgear products rated 750 kv and higher is under construction by GE **(p 80).**

Hubbard & Co's new research center for development and testing of high capacity, high voltage equipment, goes into action July 22. Short circuit currents up to 30,000 amps, simulated lightning from 3.2-Mv impulse generator, are but a few of the resources available **(p 72).**

NEMA elects J. L. Singleton president. The VP of Allis-Chalmers' industries group will fill term of late W. V. O'Brien **(p 47).**

PEOPLE ▶ **Companies can realize benefits** if more top officers "spend a little more time" discussing matters of motivating, organizing, planning, prodding and controlling their organizations, according to Streuby L. Drumm, new chief executive of West Penn Power Co, who urges more advanced management techniques **(p 70).**

T. Joseph Walsh has been promoted to vice president, Quincy Electric Co and Weymouth Light & Power Co . . . At Narragansett Electric Co a new vice president, T. Dexter Clarke, has been elected . . . Central & South West Corp has elected Frederick J. Herr as vice president . . . Sam B. Chase has been elevated to senior vice president and counsel by Montana Power Co **(p 122).**

Efficient listening is a vital link in industrial communication. It calls for aural perception and visual interpretation of ideas. Listening skill can be improved by keeping the speaker's main theme in mind, maintaining close attention, avoiding emotional and environmental interferences, and writing only the notes that are essential to retain important ideas.—**C. J. Dover, General Electric Review, May 1958.**

TECHNICAL NOTES

Use of carbon dioxide as a coolant with graphite as a moderator in a reactor imposes a limitation on the exit gas temperature because of graphite oxidation and possible carbon deposition on surfaces of the steam generator.

Europium is the most efficient neutron absorber of the rare earths. But its use as control rod material has not been attractive because it is also the most expensive of the rare earths.

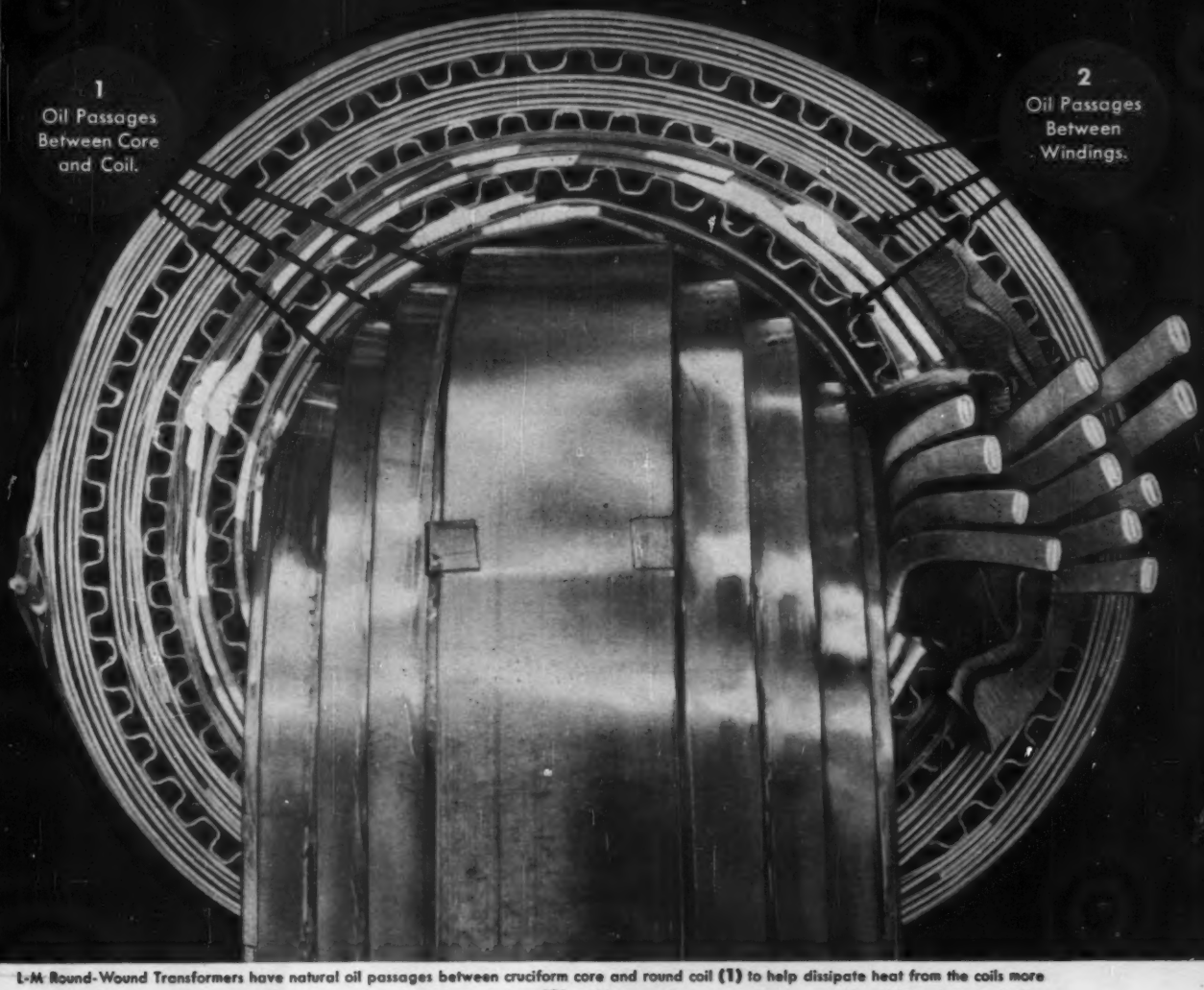
Significant errors can occur in the efficiency tests of large hydroelectric units with Kaplan turbines if tests are made with the unwatered turbine connected to the generator shaft.

FROM EDITORS IN THE FIELD

A less toxic cleaning solvent, consisting of methyl chloroform with a corrosion inhibitor, is now being used by Tennessee Valley Authority in place of carbon tetrachloride.

Mechanization of line and cable work has saved $922,000 in six years for Cleveland Electric Illuminating Co. Additional equipment which cost $153,000 in 1957 is credited with $355,000 savings.

Males cause more trouble than females—at least in one phase of life. Southern Nevada Power Co reports trouble caused by male black birds sitting on the radome of a microwave antenna which was mounted on the same tower with another antenna. The beam of one antenna was reflected by the bright feathers of the male birds (females have dull ones) into the other antenna.



L-M Round-Wound Transformers have natural oil passages between cruciform core and round coil **(1)** to help dissipate heat from the coils more rapidly. In addition, ducts provided by spacers placed between windings **(2)** and between layers in most sizes provide additional oil circulation.

Why More Customers Are Selecting L-M Round-Wound® Transformers

Many factors enter into transformer selection. Here are some of the reasons for the great increase in customer preference for L-M's obround-shape Round-Wound transformers.

Balanced Performance: The core is a continuous wound strip of oriented steel. Coils are wound directly onto this core. Since the core is not cut, unwound, or disturbed in any way after annealing, there are no air gaps to break up the flux. This results in low exciting current and core loss.

The wound-core, round-coil design permits fewer winding turns and smaller turn diameter. This results in low impedance, and provides better regulation at all power factors.

Higher Uniform-Impulse Level: Round coils are wound into shape. Therefore, insulation is not damaged by malleting into rectangular shape. Coils have longer creepage distance between windings and between leads.

Higher Short-Circuit Strength: Round coils are not stressed out of shape under high radial short-circuit forces. Strong steel frame, heavy clamping bolts, sturdy maple blocks and varnished coils prevent axial movement.

Higher Short-Time Overload Capacity: Round coils and the cruciform cross-section core expose large surfaces to cooling oil. The result is relatively low hot-spot temperatures, which add considerably to high short-time overload capacity.

Additional Capacity on Pole: L-M's new obround tank design makes the unit smaller and lighter, with shorter moment arm from the pole. This combination reduces bending moment on the pole and crossarms, and thus greatly increases potential capacity of existing transformer structures.

Get Complete Information

Ask your L-M Field Engineer for complete information and bulletins on L-M's Round-Wound Transformers. Or write Line Material Industries, Transformer Division, Zanesville, Ohio.

396-R

LM® LINE MATERIAL
McGRAW-EDISON COMPANY

"X-RAY" VIEW of the SRT, showing the volt-sensitive regulating mechanism at the top of the core-coil assembly and the under-load tap changer at the lower part. SRT's will be available in the following ratings:

2400 volts, 10 through 25 kva
4160 volts, 10 through 37½ kva
4800 volts, 10 through 50 kva
7200 and 7620 volts, 10 through 75 kva
12,000 and 14,400 volts, 10 through 100 kva

L-M Announces the

SRT

THE WORLD'S FIRST

Self-Regulating distribution Transformer

A Revolutionary New Engineering Development That Offers Utility Companies Better Revenue, Better Service To Their Customers

By A. R. WAEHNER
Director, Transformer Sales, Line Material Industries

The new L-M Self-Regulating Transformer consists of a Round-Wound® distribution transformer with extra taps on the *primary*, and a regulating mechanism that is volt-sensitive on the *secondary*.

The device switches primary taps, *under load*, to change the transformation ratio as needed to maintain a constant normal voltage to the customer, regardless of line or load changes. The SRT provides 10% of regulation in four 2½% steps.

Better Revenue For The Utility

The SRT is a break-through into a whole new world of customer service and profitable operation, because it corrects the voltage *at the point of use*. By maintaining proper voltage, the SRT prevents the drop in billings caused by *undervoltage*, which in the aggregate can represent a considerable loss.

Improves Service To Customers

With correct voltage, lights are brighter; television sets, clothes dryers, air conditioners, and other electrical devices operate more efficiently; ranges heat faster.

The SRT also prevents *over-voltage* from reaching the user. This greatly reduces burnouts of TV tubes, and of incandescent lamps—the latter a very obvious saving to a utility with a lamp-replacement program.

The SRT is another outstanding contribution of The Thomas A. Edison Laboratories of McGraw-Edison Company.

Features Of The SRT

Adapt-a-Tap Range Selector: The SRT provides a full 20% range within which taps for the 10% automatic regulation in four 2½% steps may be selected—all below, straddle, or all above normal. Thus the SRT can be located anywhere on the line—the end, the middle, or near the substation.

Nominal 3¼-Volt Band Width: The midpoint is set, for example, at 120 volts. The SRT changes taps whenever the voltage drops to 118¼ or rises to 121¾. Each operation occurs only after a time delay, which prevents undesirable operation and "hunting" on switching surges and momentary variations outside the band width.

Reliability: One 2400-volt tap changer has now operated more than 250,000 times—equivalent to over 40 years' life on a 25 kva transformer.

Economy: Under normal conditions the SRT will prove more economical than other means of voltage correction. Thus it opens unlimited horizons to the distribution-system planning engineer for more effective design.

Available For Tests

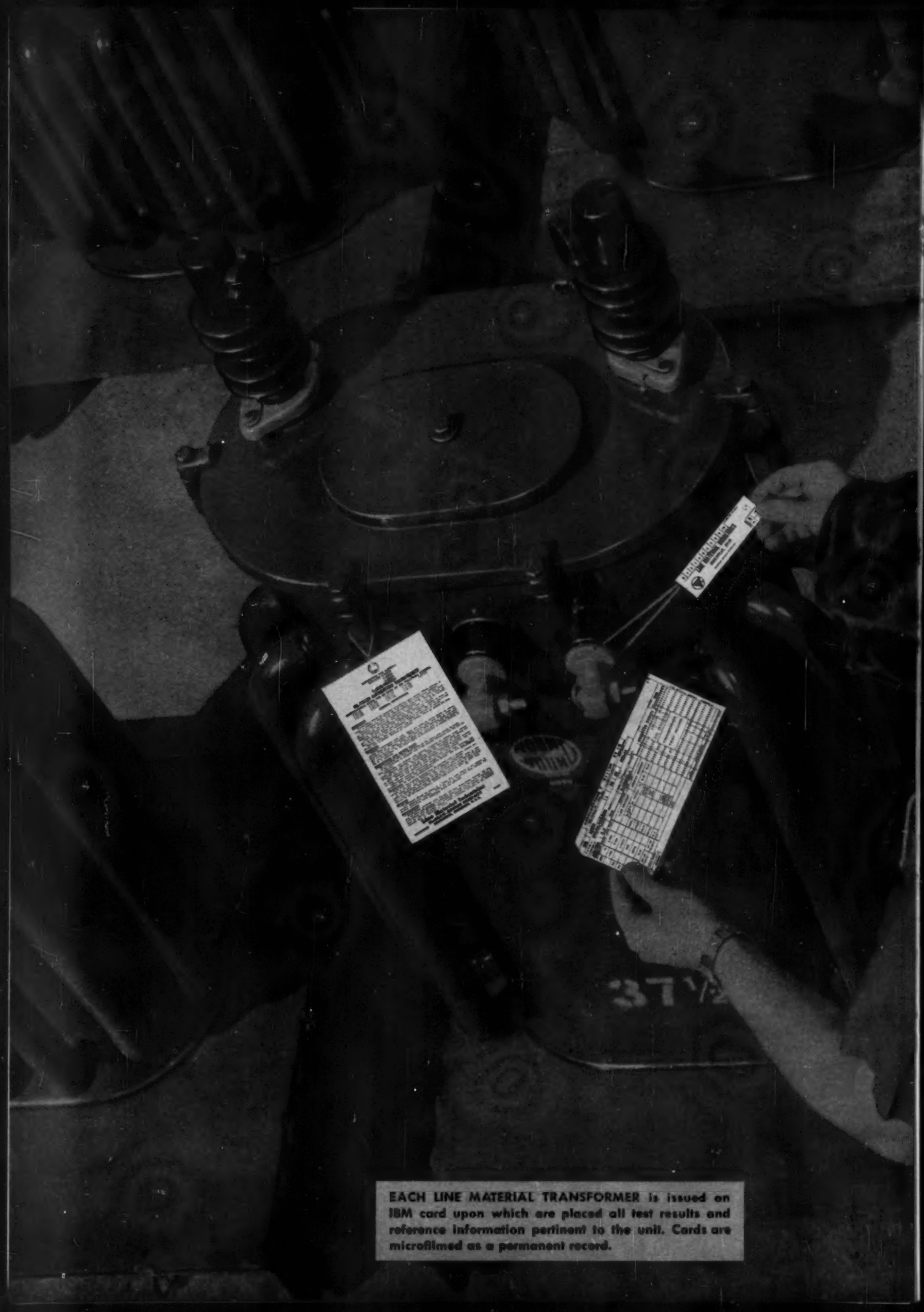
The initial production of the SRT will be sold to progressive companies to explore the benefits, in improved revenue and better customer service, that are available from this outstanding new development. Thus each company can learn, for itself, the extent to which the SRT can make a substantial contribution toward keeping revenue up and costs down.

Get The Details

L-M Field Engineers and Apparatus Specialists can furnish detailed information about the SRT. If you would like this information, please get in touch with your L-M Field Engineer, or phone or wire me at Line Material Industries, Milwaukee 1, Wisconsin.

LINE MATERIAL Industries
McGRAW-EDISON COMPANY
Distribution Transformers

McGRAW EDISON



EACH LINE MATERIAL TRANSFORMER is issued on IBM card upon which are placed all test results and reference information pertinent to the unit. Cards are microfilmed as a permanent record.

How L-M's Quality-Control System Insures High Transformer Standards

By **ROBERT P. THOMPSON**
Manager of Engineering
Transformers
Line Material Industries

Performance characteristics of L-M Round-Wound® transformers are outstanding. Physical features are exceptional. Quality is *built in* to L-M transformers, not tested in. To make doubly sure of maintaining uniformly high quality, L-M has established a very tight quality-control system.

Continuous tests are made—from raw materials to finished product. A final assurance of quality is the permanent microfilmed record of test information kept on every L-M transformer.

CORE TESTING: The tolerance permitted in testing the bare core of L-M's Round-Wound transformer is much more stringent than required by NEMA and ASA of core performance in the completed transformer.

The specially trained craftsmen who make Round-Wound transformers take pride in the high quality of their work—no small contribution to the continued excellence of Round-Wound transformers and their amazingly low failure rate—less than 2/10 of 1 percent!

Check on Incoming Materials

All raw materials and parts for L-M Round-Wound transformers are rigidly and systematically inspected. For example:

- Every high-voltage porcelain bushing is subjected to acceptance dielectric tests.
- Samples of all wire are tested for resistance and cross-section uniformity; coating is tested for dielectric strength, adherence, thickness.
- The cold-rolled oriented silicon steel used in making L-M's wound core is tested for physical and magnetic characteristics by means of a precision Epstein tester. Rigid standards on the loss and permeability characteristics are maintained.

In-Process Tests

A continuous "in-process" testing and inspection program is followed throughout the plant. Cores are tested for magnetic characteristics before and after copper coils are wound upon them. Coils are checked for ratio and given a mechanical inspection immediately after being wound. All finished units are thoroughly tested for leaks.

COIL RATIO TEST: Ratio and polarity are checked immediately after the coil is wound, so as to maintain close surveillance of the coil-winding operation at all times.

When the unit is completed, every transformer is given a complete series of electrical tests in strict conformity with NEMA and ASA standards. These tests include core loss and excitation current, copper loss and impedance, ratio, induced voltage, high potential, polarity, and impulse.

Certificate of Test

Each transformer is issued an IBM card which follows the unit through to completion. The card provides space for all test results. It is punched or filled in at each inspection and test station if, *and only if*, the transformer satisfactorily meets all the requirements of NEMA standards and of the L-M engineering and quality-control departments.

When the transformer is shipped, the cards are microfilmed and then stored to provide actual test data throughout the life of the transformer. This complete test information can be furnished to you at any time on any transformer.

Compare L-M's high standards of performance and outstanding physical features with other transformers; you will see why more customers are specifying L-M Round-Wound transformers.

Get Complete Information

Ask your L-M Field Engineer for complete information on the outstanding performance characteristics of L-M Round-Wound transformers and on L-M's unique obround tank. Or write Line Material Industries, Milwaukee 1, Wisconsin.

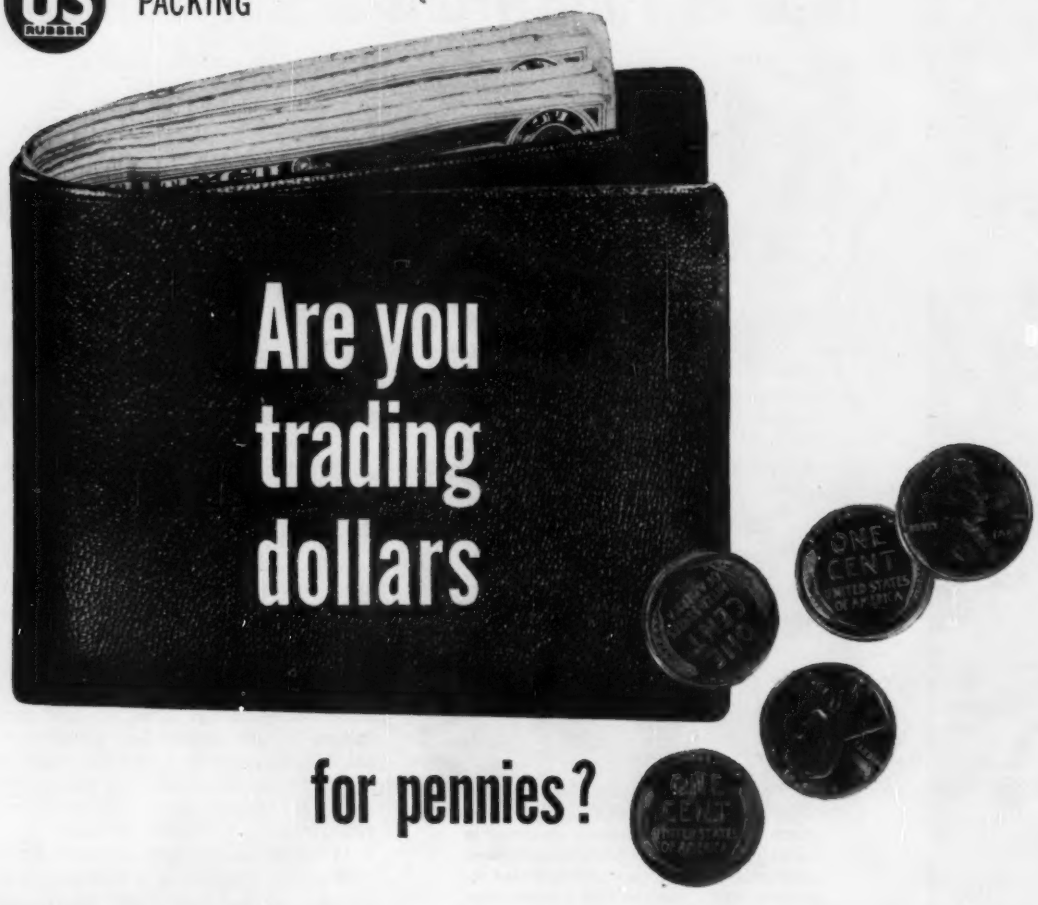
LM® **LINE MATERIAL Industries**
McGRAW-EDISON COMPANY

307

Transformers

McGRAW EDISON

US RUBBER PACKING



You may be. Consider this: How much does it cost you every time you shut down a production line to replace the packing in just one piece of hydraulic equipment? Now, multiply this by the amount of times this same equipment has had to be re-packed, say, in the past three years. And multiply this figure by the total amount of hydraulic equipment in your production system.

This downtime cost is enormous—just for packing. It's far higher than the cost of the packing itself ...and a lot more than the pennies saved by buying less expensive, inferior packing.

It's for this reason that packing like U.S. Matchless® is, by far, your most economical buy. It's made in a variety of styles, each for specific applications. Used and recommended by many of the leading original equipment manufacturers, Matchless is a packing you can trust to do the job longer, better... to turn downtime losses into uptime profits.

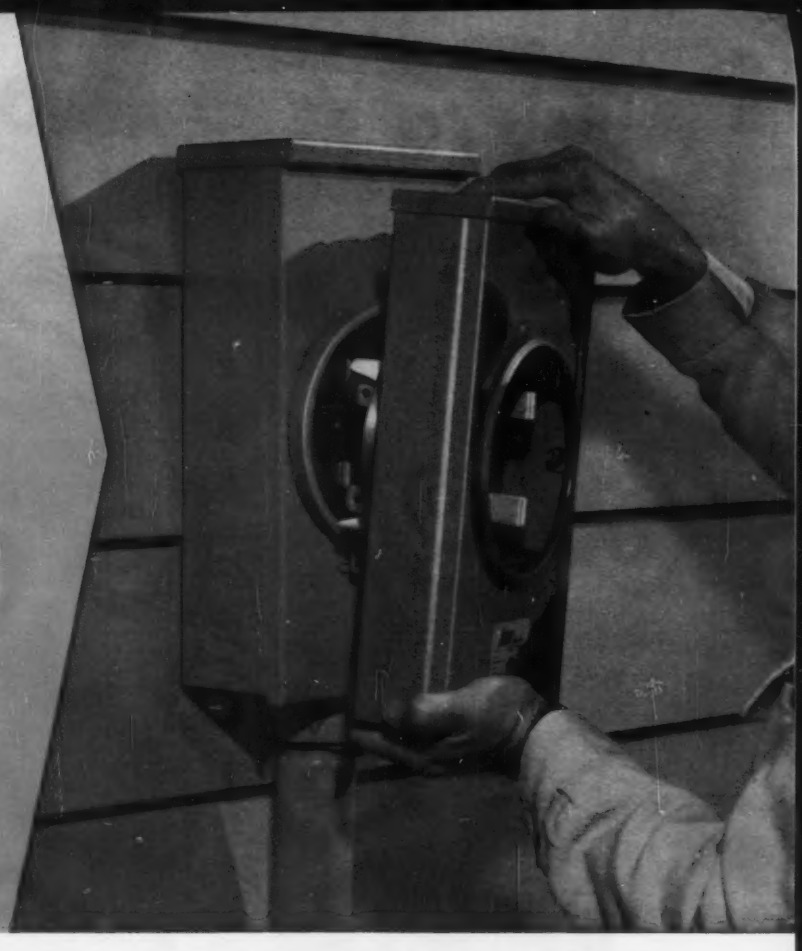
U.S. Matchless is part of a complete line of quality packings available at your "U.S." Distributor, or write us at Rockefeller Center, N. Y. 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

US RUBBER Mechanical Goods Division

United States Rubber

See things you never saw before. Visit U. S. Rubber's New Exhibit Hall, Rockefeller Center, N.Y.

BEAT THE SUMMER HEAT STORMS!



add low cost vars at point of greatest system benefit with SANGAMO SECOVAR Secondary Capacitors

The critical summer peak load is coming up fast! And with it comes the nightmare of overloaded distribution transformers and emergency changeouts.

You can avoid replacing overloaded equipment in most cases by permanently installing Sangamo Secovar Secondary Capacitors right at the meter box on your customer's premises. These 240 volt capacitors can be installed by one man—give maximum system benefits all down the line . . . from the service drop to the secondaries . . . to the distribution transformer . . . to the power transformer . . . to the generator.

They provide a quick and easy solution to the problem of unloading hot distribution transformers. Secovar Capacitors are available in two types: Type S, a 2 kvar unit for socket mounting; and Type N, a 1 kvar unit for adjacent mounting. Bulletin 1131 gives full information.

SANGAMO ELECTRIC COMPANY, Springfield, Illinois

ONE MAN INSTALLATION

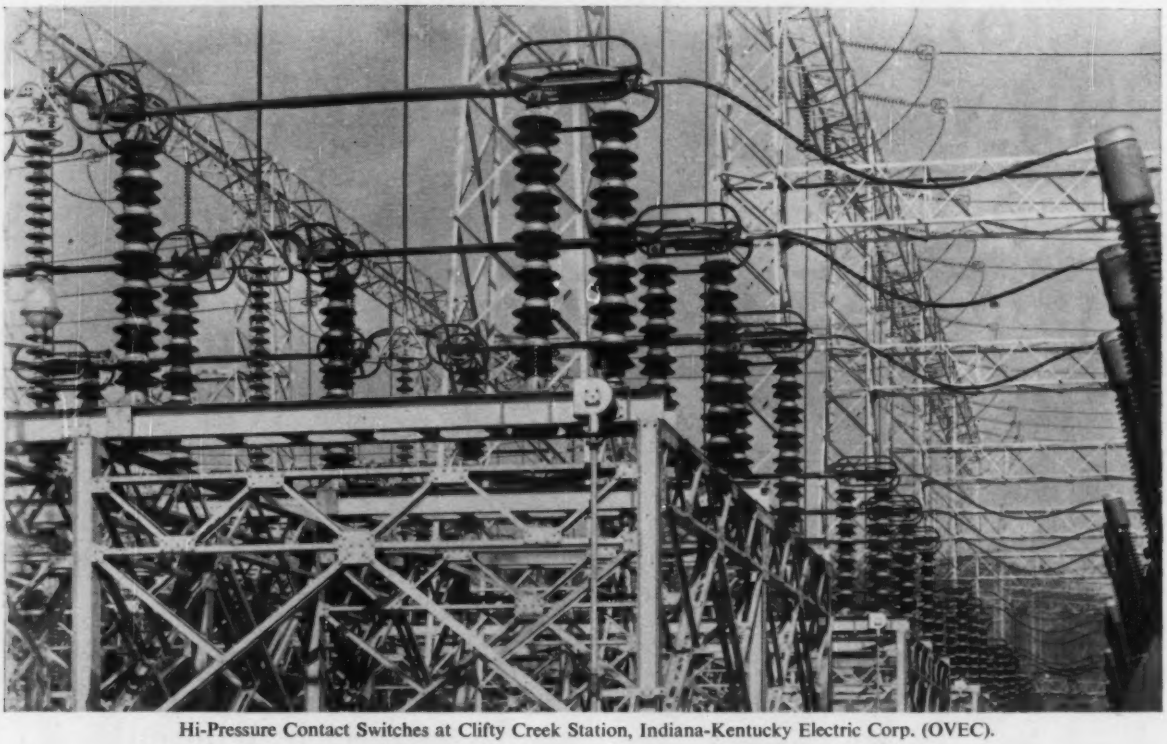
1. Plug Secovar unit into meter socket and install sealing ring.
2. Install watthour meter in Secovar socket.
3. Installation is complete—ready to supply vars to your system.

OPTIONAL THERMOSTATIC SWITCH

Automatically switches capacitor in and out on predetermined ambient temperatures. Standard range is on at 85° F.—off at 75° F.

PC58-4

R&IE **OUTDOOR DISCONNECTING SWITCHES**



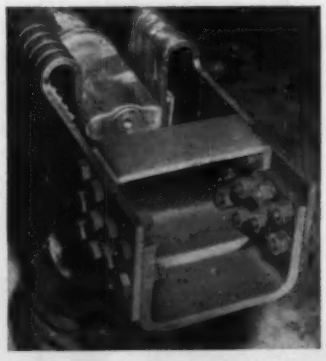
Hi-Pressure Contact Switches at Clifty Creek Station, Indiana-Kentucky Electric Corp. (OVEC).

345 KV SWITCHES FOR CLIFTY CREEK SHRUG OFF 70,000 AMP PUNCH IN JAW

The in-line jaw contacts on these Clifty Creek switches were proved long before they were placed in service. R&IE engineers applied a rigorous test—70,000 amp in three successive jolts. No damage to contacts from erosion, burning or melting resulted, and the powerful electromagnetic forces produced by these high currents caused no movement of the 13 ft. blade.

The features responsible for this trouble-free performance are found on all R&IE disconnect switches, differing only in configuration based on the required short time current rating. All have massive silver-to-copper contacts to maintain low contact resistance and to allow rapid transfer of heat away from the contact surfaces under fault conditions. All have nonannealing beryllium copper contact supports to provide maximum spring force and resilience for efficient current flow and for maximum resistance to electromagnetic forces.

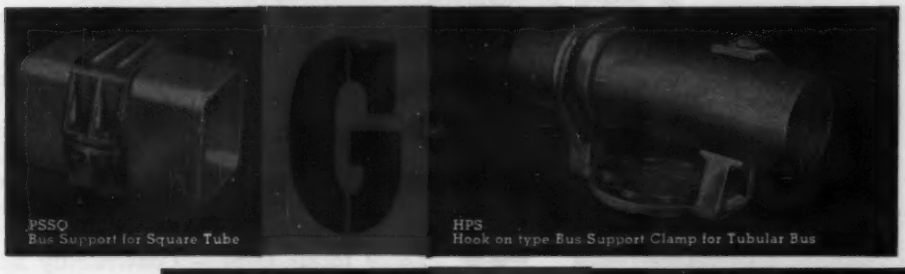
Better designed contacts are only one of the many extra features built into the R&IE switches at Clifty Creek and available to you . . . at no extra cost . . . in a wide variety of R&IE disconnect switches in other ratings from 7.5 kv. Learn how these features can benefit you by contacting your nearby I-T-E sales office. Or write R&IE Equipment Division, Greensburg, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

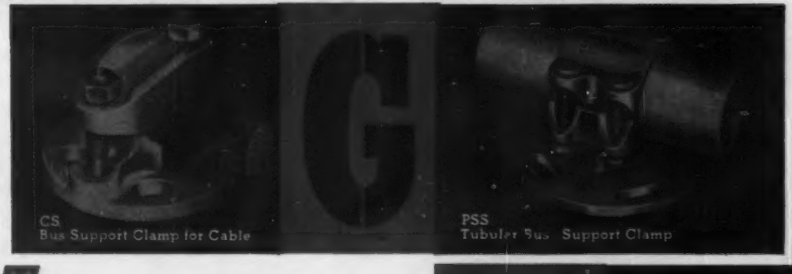


In-line jaw contact for 100,000 amp momentary current. At high currents, magnetic forces increase contact pressure and hold blade stationary.

I-T-E CIRCUIT BREAKER COMPANY

R&IE EQUIPMENT DIVISION · Greensburg, Pa.





DOSSERT HIGH-STRENGTH BUS SUPPORTS

•Higher cantilever strength • Higher impact resistance
•Higher corrosion resistance • Greater durability

These Dossert Bus Supports are made of a high tensile strength cast bronze alloy and are equipped with silicon bronze bolts and nuts, making the entire unit completely non-magnetic. Available for all sizes and types of busses. Dossert Bus Supports can also be furnished in Coupling, Tee Connecting, Elbow Connecting, Tee Coupling and Expansion Connection types.

Special fittings and modifications can be readily supplied on short notice.

50 YEARS OF TECHNICAL LEADERSHIP

DOSSERT MFG. CORP.

249 Huron Street, Brooklyn 22, N.Y. • Representatives in all principal cities
IN CANADA: W. S. Gerrie & Assoc., Ltd., Toronto

"Sure, There's a Difference in Hardware"

AND HERE ARE FEATURES THAT MAKE THE DIFFERENCE

Hardware for distribution deadends may look much the same at first glance regardless of who made it. But on closer examination, you'll find important points of difference.

For example, consider just a few of the features of O-B deadend clamps — quadrant, Universal, Strateline — features that make them simple to install and free from maintenance problems. Other clamps may have some of these features, but they don't have them all.

1. *Stainless steel cotters* on all aluminum clamps — To assure complete compatibility of materials.
2. *Rounded nuts and U-bolts* — More expensive to make, but less expensive to install. Also important — sharp corners are eliminated, reducing the chance of electrical stress and radio interference at higher voltages.
3. *Large tackle loops* — Conveniently located for easy application of hoists and other tackle.
4. *Captive keeper pieces* on small quadrants, Strateline and new 88500 Universal clamps — Fewer loose parts for linemen to worry about.

Use clamps with these features, and your linemen will thank you for making their job easier. And years from now, you'll thank yourself for having the foresight to build with O-B hardware.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

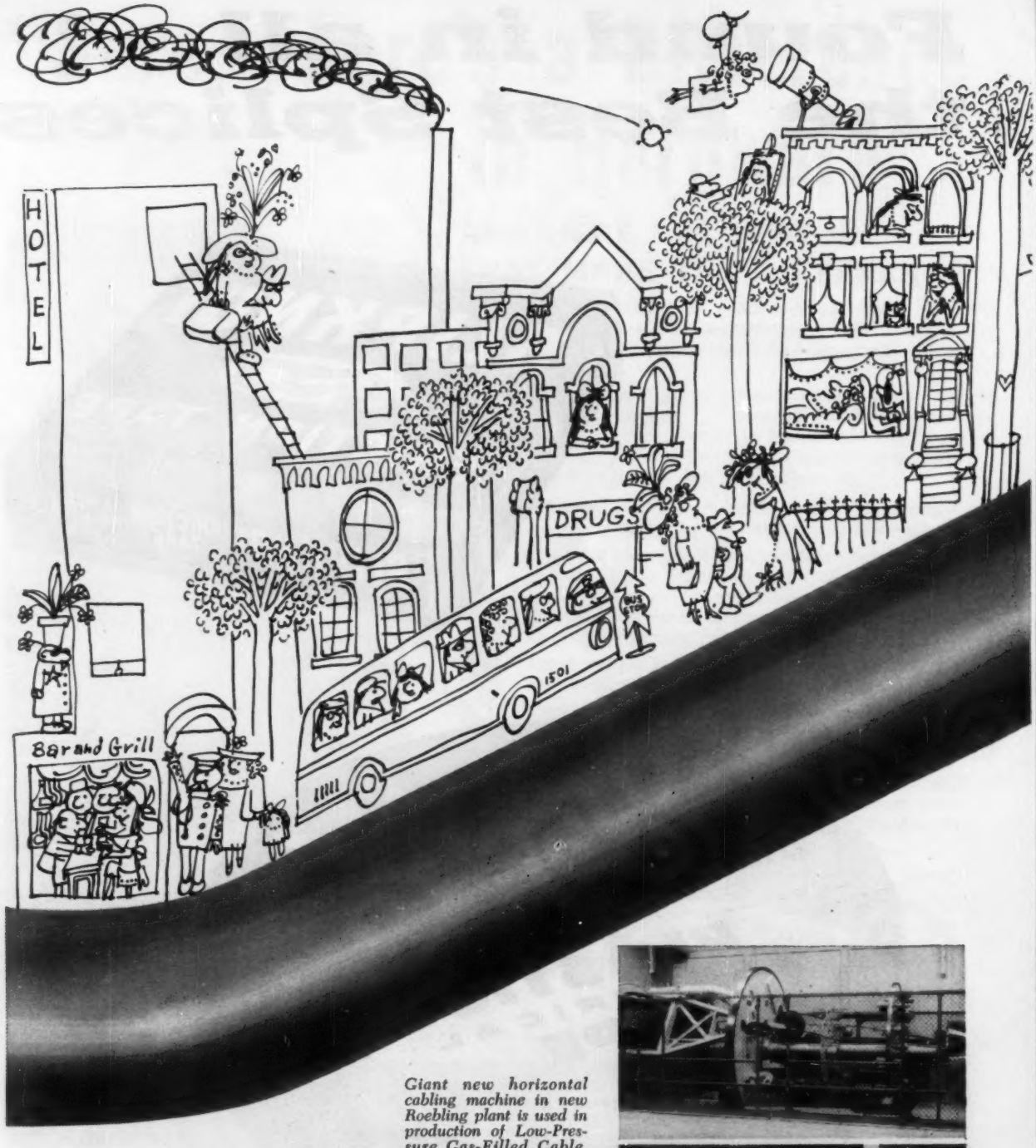
4862-H

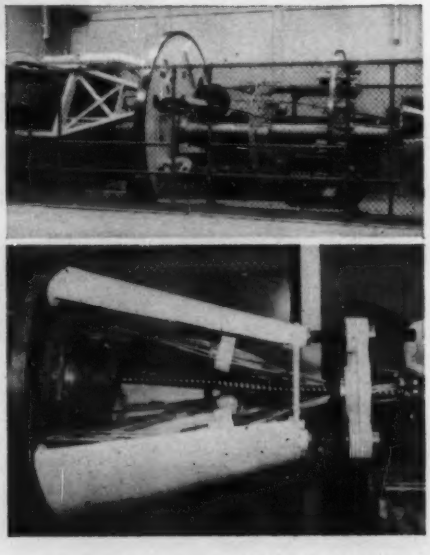
Found in all the Best Splices

With the only practical on-the-job tape cutter in the industry — FREE

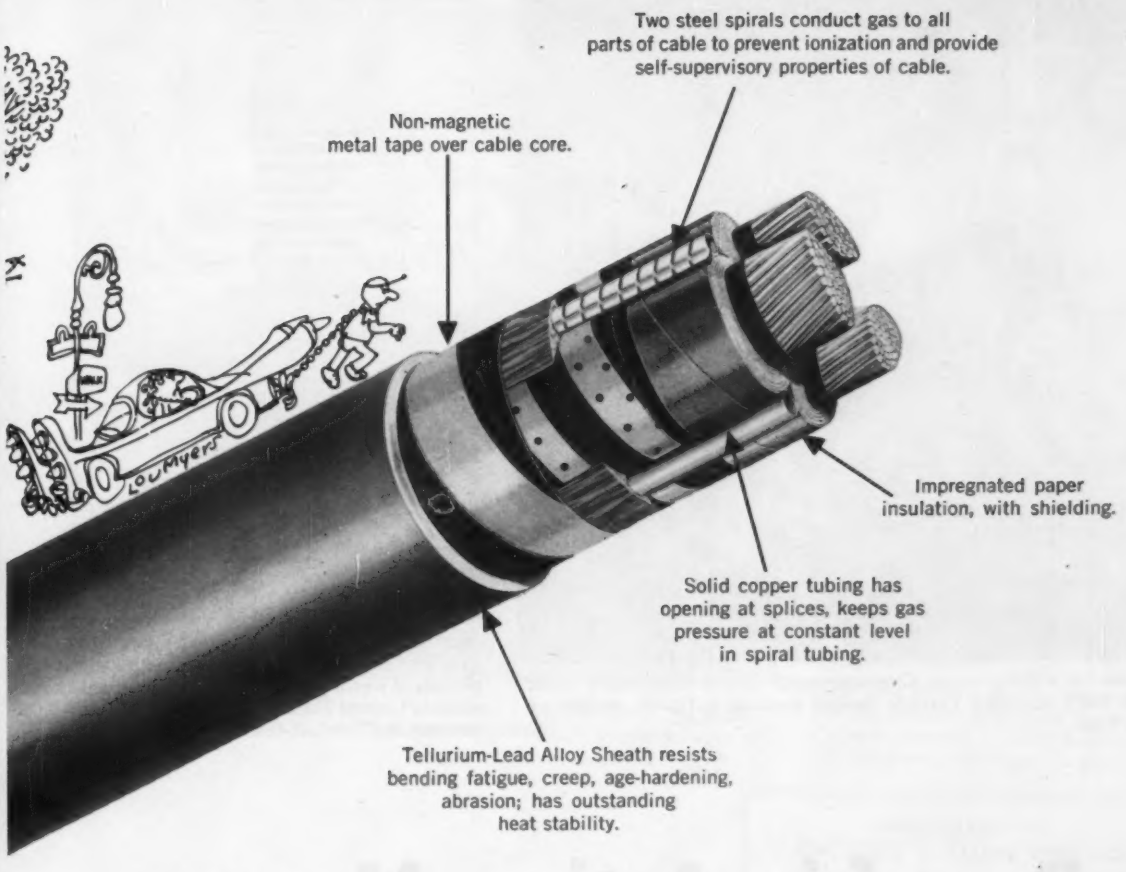
PLYMOUTH RUBBER COMPANY, INC.

DIVISION 19 CANTON, MASSACHUSETTS





Giant new horizontal cabling machine in new Roebling plant is used in production of Low-Pressure Gas-Filled Cable. Here spirals, tube, insulated conductors and paper fillers are formed into cable.


Two steel spirals conduct gas to all parts of cable to prevent ionization and provide self-supervisory properties of cable.
Non-magnetic metal tape over cable core.
Impregnated paper insulation, with shielding.
Solid copper tubing has opening at splices, keeps gas pressure at constant level in spiral tubing.
Tellurium-Lead Alloy Sheath resists bending fatigue, creep, age-hardening, abrasion; has outstanding heat stability.

FOR **UPHILL POWER** PROBLEMS
ROEBLING GAS-FILLED CABLE!

Packs more power in less space than solid-type cable!

When power circuit profiles include steep grades, there's no better means of power transmission than *Roebling Low-Pressure Gas-Filled Cable!* Here's why. When a solid-type cable is used for an installation of this kind, its oil impregnant inevitably drains to the bottom of the grade. Result? At the top, the cable becomes vulnerable to ionization. And oil pressure build-up at the base of the grade rapidly causes a rupture in the lead sheath, resulting in cable failure.

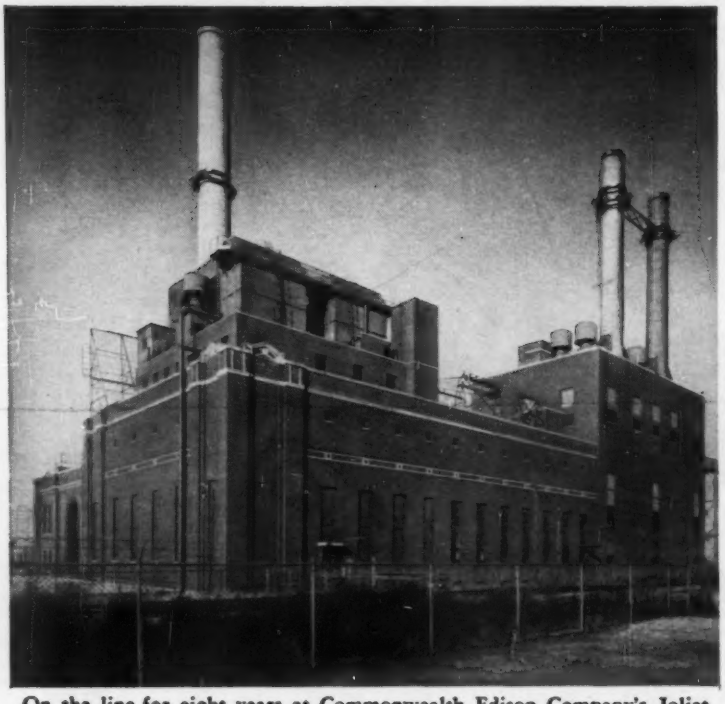
Roebling Low-Pressure Gas-Filled Cable (for voltages up to 46 kv) ends both these problems . . . and has other benefits besides! Dry nitrogen gas, inside the cable at approximately 12 psi pressure, effectively suppresses ionization. From the top of the grade to the bottom, internal pressure is uniform.

Another major advantage of Roebling Gas-Filled Cable is that it is self-supervisory. An alarm system immediately tells you if there's trouble along the line. And because this cable carries more power in a smaller diameter, existing manholes and conduits do not have to be altered.

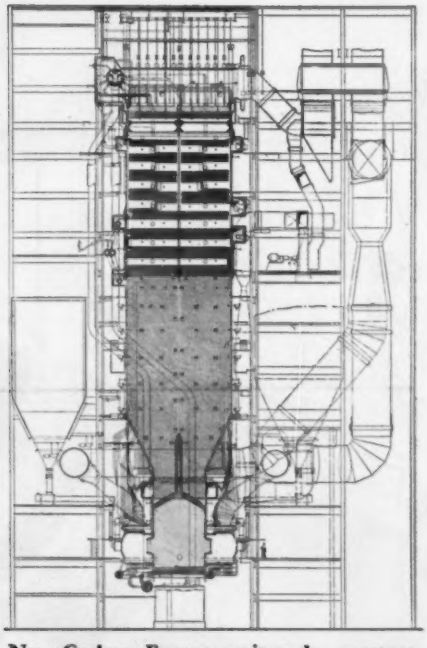
If you have had trouble making power cable behave on grades (or anywhere else), call your Roebling Field Representative *today* about Roebling Low-Pressure Gas-Filled Cable! And for an eye-opening brochure, write Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, N. J.

ROEBLING

Branch Offices in Principal Cities • Subsidiary of The Colorado Fuel and Iron Corporation



On the line for eight years at Commonwealth Edison Company's Joliet Station, 2 B&W Cyclone Furnace Boilers produce 1,200,000 pounds of steam per hour.



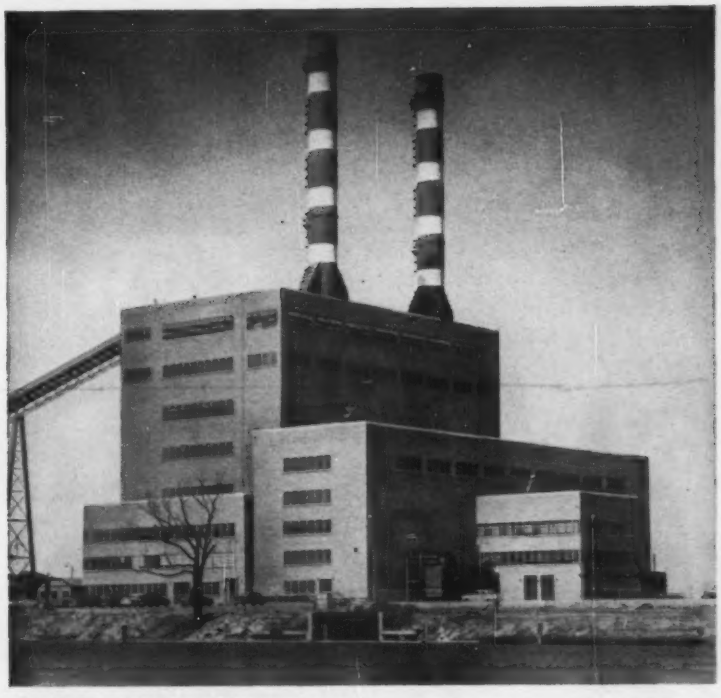
New Cyclone Furnace unit under construction for Joliet Station will generate 2,200,000 pounds of steam per hour. It will burn highly volatile Central Illinois coal with a high ash content and low ash-fusion temperature.

Proof in Action Means Continued Acceptance for B&W Cyclone Furnaces

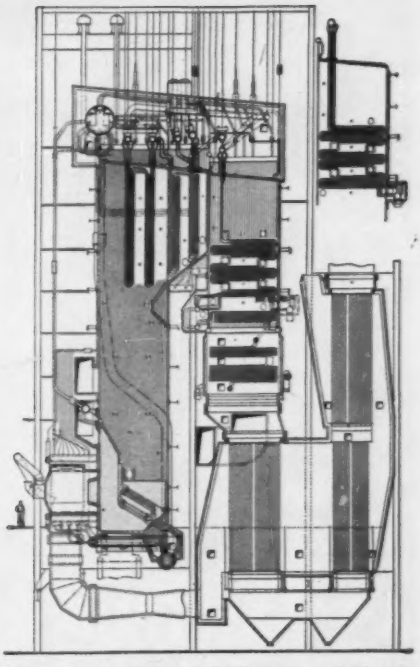
ON-LINE UNITS PROVIDE MODERN MEANS OF BURNING FUEL ECONOMICALLY

In installation after installation, the efficiency, economy and simple operation of B&W Cyclone Furnaces have led to continued acceptance. At the Commonwealth Edison Company, where the first Cyclone Furnace was installed in 1944, 14 additional units are in operation with still another on order. And at Wisconsin Power and Light Company's Edgewater Station, a Cyclone-Fired Boiler achieved such an outstanding record that B&W Cyclone Furnaces were also specified for that Company's Rock River and Nelson Dewey Stations.

The B&W Cyclone Furnace simplifies the entire process of coal preparation, combustion, ash handling and ash segregaton. Its cost-saving quality contributes to lower fuel costs and re-



Rock River Station of Wisconsin Power and Light Company. Six B&W Cyclone Furnaces fire 2 B&W Boilers to produce 1,050,000 pounds of steam per hour.



New unit for Wisconsin Power and Light's Nelson Dewey Station will use a B&W Cyclone Furnace to fire boiler producing 700,000 pounds of steam per hour.

duced maintenance as well as increased operational simplicity, flexibility and safety. Recognition of these facts is attested by the 77 Cyclone Furnace Boilers now either in service or under construction throughout the country.

Many other modern advances in combustion and high-pressure, high-temperature steam generation are also available through B&W. They merit examination in connection with your next installation. Write for further information to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

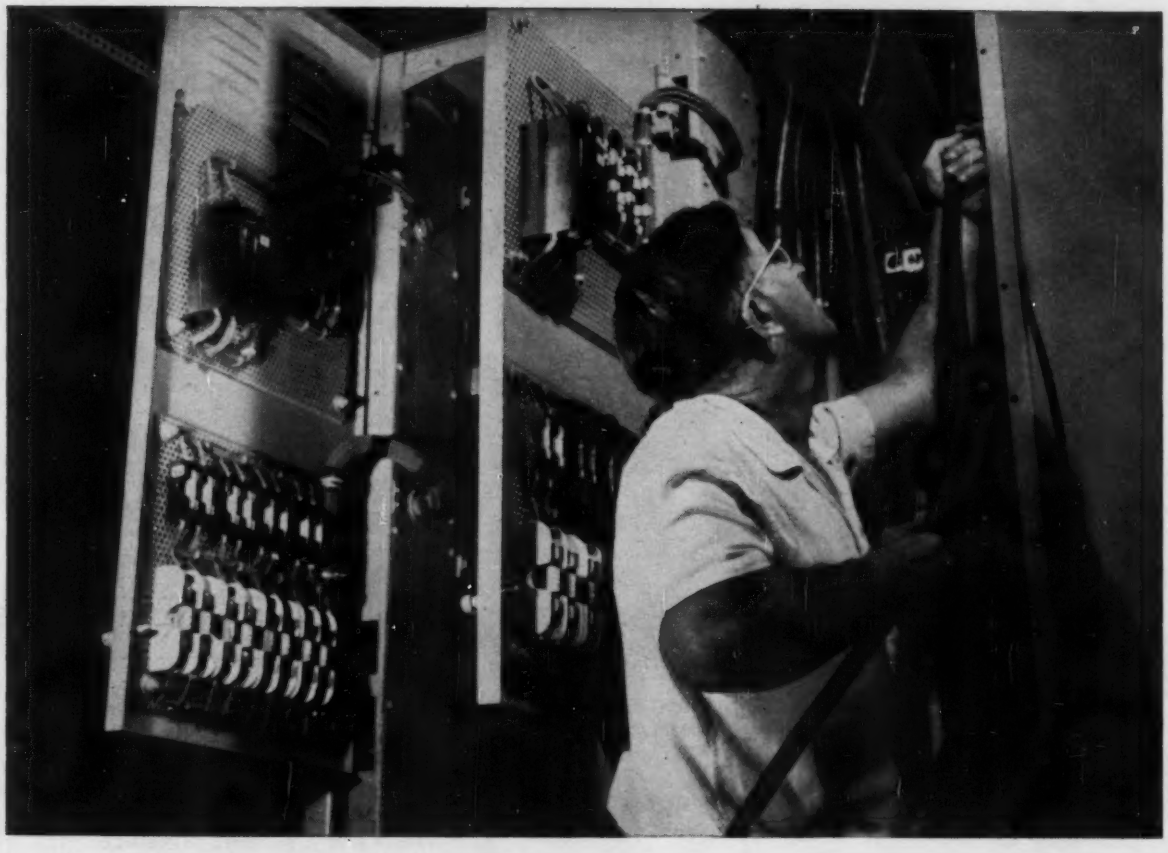
PURCHASERS OF THE B&W CYCLONE FURNACE

FOR CENTRAL POWER STATIONS	Number of Cyclone Furnace Boilers
Atlantic City Electric Co.	1
Baltimore Gas & Electric Co.	1
Chilena de Electricidad	2
Columbus & Southern Ohio Electric Co.	2
Commonwealth Edison Co.	16
Consumers Public Power District (Nebraska)	1
Detroit Edison Co.	1
Indiana & Michigan Electric Co.	1
Jersey Central Power & Light Co.	3
Memphis Light, Gas & Water Division	3
Middle South Utilities, Inc.	1
Missouri Public Service Company	2
Monongahela Power Co.	1
Northern Indiana Public Service Co.	3
Ohio Edison Co.	2
Ohio Power Co.	6
Public Service Co., of New Hampshire	1
Tampa Electric Co.	3
United Illuminating Co.	2
Wisconsin Power & Light Co.	4
FOR INDUSTRIAL INSTALLATIONS	
American Cyanamid Co.	1
American Enka Corp.	1
Clinton Corn Processing Co., Division of Standard Brands	1
Columbia Southern Chemical Co.	1
Consolidated Water Power & Paper Co.	1
Dow Chemical Co.	5
Eastman Kodak Co.	1
Greenwood Mills	1
International Paper Co.	4
National Container Corp., of Wisconsin	1
Rhinelander Paper Co.	1
St. Croix Paper Co.	1
Thilmany Pulp & Paper Co.	1
West Virginia Pulp & Paper Co.	1
Total	**77**

BABCOCK & WILCOX

BOILER DIVISION

G-887



When you must pack a lot into a small space . . . specify Rome's "CT-2" control cable

These cables are intended for installation in underground conduits or ducts, directly in the earth, or open air.

Conductors: Conductors conform to ASTM Specification B-8.

Insulation: Insulation conforms to IPCEA Appendix P.

Color Coding: All conductors shall be color-coded in accordance with IPCEA recommendations.

Assembly: For three conductors or more, the insulated color-coded conductor shall be twisted with jute fillers when necessary to make round, and a suitable tape shall be applied over the assembled core. Two-conductor cable shall be flat.

Over-all Sheath: An over-all sheath of Rome Synthinol* shall be applied over the tape core.

Here's a way to speed up the job of making complex control-panel connections in tight quarters. Install cable that meets your *budget, quality,* and *space* requirements.

You'll find that just such a cable is Rome's "CT-2" control cable. Its smaller diameter will fit into your most compact panel arrangements. It's lightweight, too, and easy to pull through conduit. And it represents good quality at moderate cost.

Your choice of cable sizes

This low-surface-friction cable has an all-thermoplastic construction featuring 3/64" Rolene insulation (polyethylene) plus an over-all sheath of Rome Synthinol (polyvinyl chloride).* It's available as a standard construction with one to 12 conductors in No. 9 and No. 12 AWG sizes.

Insulation: Sure and dependable terminations are possible because Rolene strips cleanly. This smooth, positive-stripping polyethylene lets you consistently make an efficient installation.

Sheath: Rome Synthinol is a thermoplastic (PVC) compound that offers high resistance to oils, most acids, alkalis, grease, gasoline, weathering and flame.

Use Rome's "CT-2" control cable for your next job where space is at a premium and fast, efficient installation is mandatory.

Find out how Rome's control cable can fit your installation picture. Contact your nearest Rome Cable representative—or write to Department 852, Rome Cable Corporation, Rome, N. Y.

*Alternate sheaths of Rolene (polyethylene) or Roseal (flame-resistant polyethylene) are also available.

ROME CABLE

CORPORATION

NEW COVER:

Bushing openings in the tank cover have smooth, curved flanges thereby eliminating the possibility of moisture entering the tank or collecting on cover.

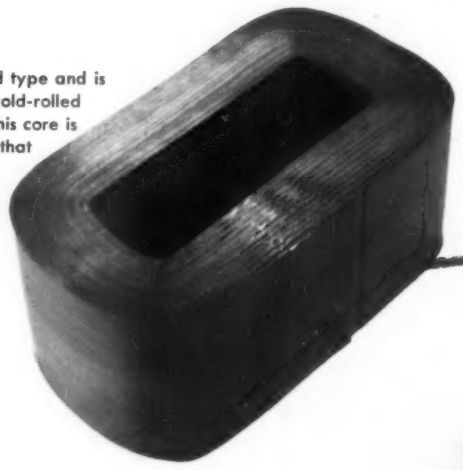
All cover clamps are now made of corrosion proof Almag castings.

NEW COIL:

The coil has been redesigned to obtain lower impedance and reduce core and copper losses, resulting in improved regulation and higher efficiency. This coil has the same high short circuit strength and insulation strength inherent in all Moloney Transformers.

NEW CORE:

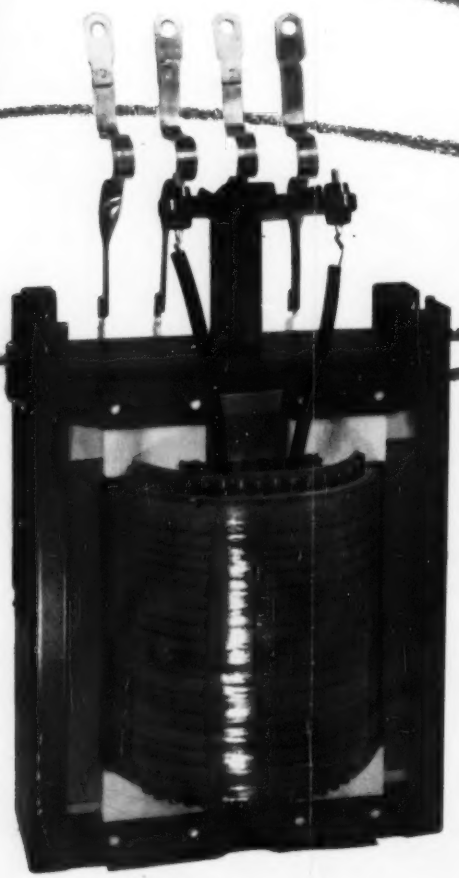
The new core is of the wound type and is made of high permeability, cold-rolled grain-oriented silicon steel. This core is constructed in such a manner that every air gap is bridged resulting in lower exciting current and reduced core losses.



NEW BUSHINGS:

The redesigned bushings have very liberal creepage distance without excessive height and the new configuration gives the porcelain high impact strength.

Bushing connectors are tin-coated to accommodate either copper or ACSR conductors. The connectors have openings large enough for the ACSR equivalent of the copper sizes specified by EEI-NEMA Standards.



NEW FRAMES:

The frames are designed to hold the core and coil unit in position under all conditions of operation and handling. Frames are bolted together thereby assuring positive clamping. Strong, adequate blocking keeps the coils in their proper position even under severe short circuit.

Features of the NEW DESIGN are:

- LOWER EXCITING CURRENT
- LOWER IMPEDANCE
- LOWER LOSSES
- IMPROVED REGULATION
- LIGHTER WEIGHT
- LESS MAINTENANCE

The complete line of pole type distribution transformers has passed all standard tests and Moloney's own rigorous design-proving tests.

The first of these new units are in service and Moloney Now has in production the entire New Line of Distribution Transformers.

To obtain the improved performance and operating characteristics Moloney Engineers developed a new core and coil, improved the core and coil framing structure, and redesigned the bushings and tank cover.

MOLONEY ELECTRIC®

Bulletin No. H 307-658

NEW NEW NEW

NOW IN PRODUCTION A NEW LINE OF MOLONEY DISTRIBUTION TRANSFORMERS

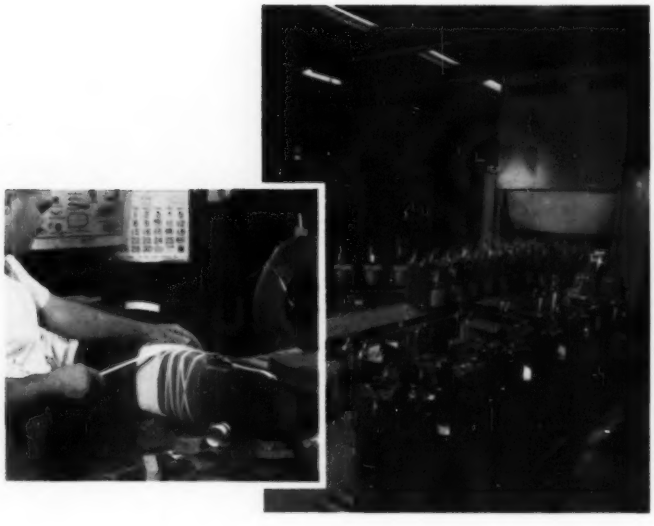
15

NEW INSIDE . . . NEW OUTSIDE . . .

COMPLETELY REDESIGNED TO GIVE THE PURCHASER A BETTER TRANSFORMER . . . BETTER ELECTRICALLY AND MECHANICALLY

PULL

COMBINE THIS NEW LINE OF DI
OF THE LATEST DESIGN WITH M



- MODERN HIGHLY MECHANIZED
- AUTOMATIC TEST FACILITIES
- THOROUGH INSPECTION PROC

AND THE BEST OF DISTRIBUTION

F DISTRIBUTION TRANSFORMERS
TH MOLONEY'S . . .

NIZED PRODUCTION LINES
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PROCEDURES

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UTION TRANSFORMERS ARE OBTAINED

TAKE ADVANTAGE OF THE IMPROVED PERFORMANCE
AND OPERATING CHARACTERISTICS OF MOLONEY DISTRIBUTION
TRANSFORMERS MADE POSSIBLE BY MOLONEY'S
CONTINUOUS RESEARCH AND DEVELOPMENT PROGRAMS
. . . SPECIFY MOLONEY TRANSFORMERS . . .
ALL ALONG THE LINE.
CONTACT YOUR MOLONEY REPRESENTATIVE FOR COMPLETE INFORMATION

MOLONEY ELECTRIC COMPANY

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA

July 14, 1958

AIEE Needs A Stronger Summer Meeting

No one truly interested in the electrical industry and in the electrical engineering profession wants to see the demise of the Summer General Meeting of the American Institute of Electrical Engineers. Yet today there are several factors at work which, if allowed to go unchecked, can lead to that end.

First is the continuing inclination to make the Summer Meeting more a "social affair" and less a "technical forum" than the other General Meetings. The results is a drop in attendance and a deterioration of its technical status in favor of the more serious, "working meetings."

Second factor at work is the preoccupation of the industry's engineering statesmen and thought leaders with committee activities and matters of Institute administration during the Summer Meeting. Committee rooms are full but attendance at technical sessions sags and meaningful discussion of papers dwindles. Down with it goes the value of the meeting as an engineering forum.

Third influence threatening status of the Summer Meeting is an outgrowth of the first two; a noticeable deterioration, over the past five years or so, in the calibre and quality of technical papers offered for presentation. It seems apparent that both authors and technical committees, today, prefer to hold their most significant contributions for presentation at the other general meetings where attendance is higher and the presence of specialists more apt to produce significant and thoughtful discussion.

The electrical industry today is developing too fast and the pace of technical and scientific progress has become too rapid on all fronts to permit the deterioration of any of the Institute's general sessions.

In the electrical engineering profession progress can best be served through a pattern of general meetings of equal technical stature uniformly spaced throughout the year. If any general meeting is allowed to deteriorate, it can only mean delay in paper presentation and further crowding of other meetings already too crammed with sessions and papers to permit thorough presentation and exhaustive discussion of worthwhile papers.

Certainly no one wants to see the passing of the Summer General Meeting. Yet if this is to be avoided, it remains the task of the Institute to build it up to equal professional standing and prestige with other sessions.

Administrative functions seem to be the crux of the problem. Perhaps most of them should be scheduled for a separate meeting where they would not conflict with essential technical sessions. If this course was followed, the administrative functions could be handled in a more exhaustive manner. Programs and speakers could cover broad AIEE policies and practices. And policy matters could be hammered into shape in a much shorter time.

We do not have any pat answers but we do suggest that this problem be given careful consideration by the AIEE Board of Directors.

Moon Lake Line Poses 64,000-Kw

Utah P&L and Southern Wyoming Utilities want to know what the co-op will do with excess power after Flaming Gorge Dam is completed; USBR handling of bids questioned

The Rural Electrification Administration put its final seal of approval June 25 on a $4,246,000 loan to Moon Lake Electric Association, Inc, Utah, for a generation and transmission project, which has all the makings of a major controversy within the next ten years.

In fact, several private companies in Moon Lake's area already are calling for a Congressional review of the situation.

Involved is a Bureau of Reclamation contract for Moon Lake to supply 7,000 kw for construction on Flaming Gorge Dam. The Reclamation Bureau made the award May 16 to the co-op, which beat out Southern Wyoming Utilities Co in the third round of competitive bidding between the two.

Earlier Moon Lake had applied to REA for a loan to add 14,000 kw of diesel generating capacity and new transmission lines to its system to handle the Flaming Gorge contract plus "increasing power demands of its consumers" and "new loads materializing in its service area." Included in Moon Lake's plan is a 35-mile 115-kv high line to the Flaming Gorge site—which, Southern Wyoming and Utah Power & Light Co point out, is far bigger than necessary to supply the 7,000 kw under contract. Southern Wyoming had planned a 69-kv line to supply the same power to Flaming Gorge.

The private companies estimate that the line planned by Moon Lake could be used to take something like 50,000 kw out of Flaming Gorge—on preference status—when the dam is finished. This block of power, along with the 14,000 kw of added diesel generating capacity, brings up the 64,000-kw question —How does Moon Lake plan to use it?

The co-op presently has about 2,500 consumers and a firm generating capacity of 8,634 kw. According to its application with REA, there will be about 2,900 customers connected by 1968.

Two answers seem likely: **1.** Moon Lake may be planning to sell up to 50,000 kw to a phosphate plant proposed by Stauffer Chemical Co; **2.** Moon Lake could sell surplus energy to utilities in the area—such as Uintah Power & Light Co.

Utah P&L has written numerous Congressmen, urging a review of the Moon Lake situation, as it fits into the intent of Congress when the REA Act was passed in 1936. Chances of such an investigation are small at this time because: it's an election year; the Moon Lake project would be past history before the probe is completed; and, while Republicans mostly would favor the study, a Congressional aide pointed out, "It's up to the Democrats to suggest hearings this year."

USBR Questioned on Bids

Utah P&L also has questioned the Reclamation Bureau's handling of the bids between Southern Wyoming and Moon Lake, which eventually went to the co-op. Reclamation first called for bids on Aug. 14, 1957, to provide power for five years to the Flaming Gorge project. Southern Wyoming had the low bid, $1,944,000 to Moon Lake's $2,133,600. The private company's bid was rejected, according to the Reclamation Bureau, because it was not a "firm" bid. That is, Southern Wyoming had stated in its bid that appropriate state and federal regulatory agencies would have to approve the contract. Moon Lake's bid also was thrown out.

In the second round of bidding—this time for only a four-year service contract—Moon Lake was low, $1,314,180 to Southern Wyoming's $1,376,592. These bids also were discarded because Washington did not believe the co-op had adequate funds to proceed with the project. On the third and final go-'round Moon Lake again was low, $1,213,-800 to $1,267,634

Pres E. M. Naughton of Utah P&L wrote Sen Arthur Watkins and Utah Gov George D. Clyde urging an investigation.

Naughton pointed out: "We have reached a sad situation when the Bureau of Reclamation will disclose the offerings of bidders and in the final award select a cooperative for a difference of $53,834 over the four-year assumed period without giving proper and just consideration to the fact that the investor-owned utility, Southern Wyoming, would return to the federal government in income taxes alone approximately $150,000, and in addition, would pay substantially more than Moon Lake for ad valorem and other taxes.

"The proposal of Moon Lake seems amazing when one considers that association does not now have the required generating capacity to provide the service and thus contemplates borrowing from the REA, at 2% interest, funds to install, in addition to the (115-kv) transmission line, internal combustion generating capacity which obviously it will not need when Flaming Gorge construction is finished and that project begins the generation of electric power. Retiring an investment of approximately $1.6-million over the short construction period obviously makes the (1¢ per kwhr) rate quoted impossible. Certainly the American people cannot be expected to furnish Moon Lake (with) duplicate systems."

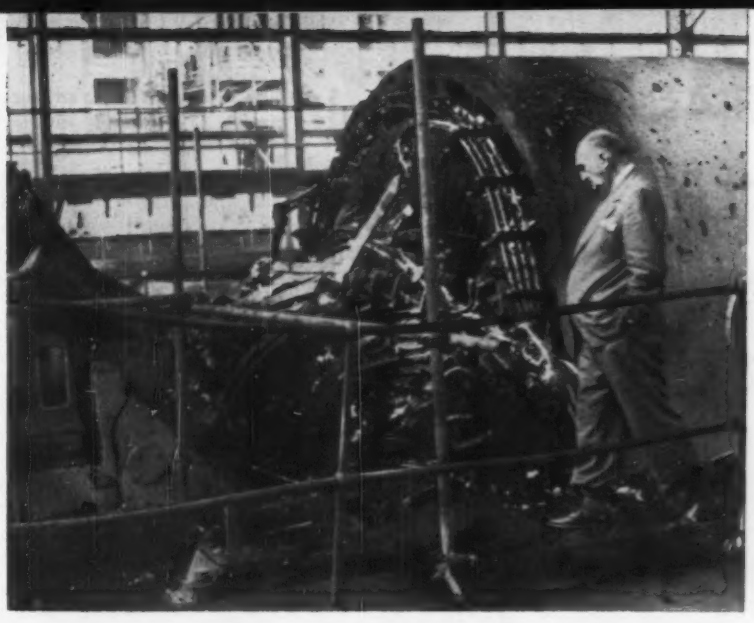
USBR Had No Alternative

Reclamation officials claim they had no alternative but to give the award to Moon Lake because the co-op offered the lower bid. Asked about the "condition" in Southern Wyoming's first bid, Don S. Campbell, chief of Reclamation's power division, said, "All I can say is that they (Southern Wyoming) didn't have any conditions in their bid on the third round."

Question

REA points out that it considered the loan on three grounds: was Moon Lake eligible, was the loan financially sound and was it needed. REA authorized the $4.2-million loan on Dec. 31, 1957, but conditioned the portion covering the transmission and service lines to Flaming Gorge on Moon Lake's winning of the contract. The bulk of the loan $2,676,907 for generating and other facilities, was cleared June 5; while the portion of the loan allocated to the Flaming Gorge project, $1,569,093, was cleared June 25.

REA claims that an apparent $355,000 net loss to Moon Lake for taking on the Flaming Gorge project —$1,569,093 costs allocated in the REA loan as against the $1,213,800 Reclamation contract— is considered financially sound on a long-range basis. This undoubtedly must assume the line's use later as a power tie-in between Moon Lake and the Flaming Gorge hydro development of 108,000 kw.



Cause of Calder Hall Blast Under Study

Investigations are underway to determine what caused a new turbine to explode during tests at England's Calder Hall Nuclear Station. C. A. Parsons, Ltd, maker of the turbine, declined to discuss the July 2 accident. Members of the firm and Atomic Energy Authority will form an investigation team to find out if the blast was caused by a fault in the turbine itself or because certain valves blocked the steam cycle of the turbine.

Some observers have placed cost of the damage as high as $800,000, including the damage to the turbine hall. The station's two nuclear reactors, housed in a separate building, where unharmed. The remaining three turbines in "B" plant turbine hall are relatively undamaged but are not operating because the No. 3 reactor is temporarily closed down for the investigation. The reactor was expected to be restarted about July 12.

Tax Repeal Brings Break To Buyers of Coal, Oil

Buyers of coal and oil should be getting a break this week as a result of the action by Congress repealing the federal freight tax on those fuels.

The tax law that President Eisenhower signed just ahead of the June 30 deadline cuts out the 4½% tax on oil transported by pipeline, and the 4¢ per ton freight tax on coal.

In the legislation, Congress extended for another year the 52% rate on corporation income, and also extended Korea-born taxes on automobiles, passenger fares, cigarettes, beer and wines. Besides the repeal of the coal and oil pipeline taxes, the new law also abolished the 3% transportation tax that had been imposed during World War II.

Observers believe this will be the only tax rate action in this session of Congress.

Singleton Elected to NEMA Post

Joseph L. Singleton, industries group vice president, Allis-Chalmers Mfg Co, has been elected president of the National Electrical Manufacturers Association. He fills the vacancy of the late W. V. O'Brien for the term expiring in November.

A native of Chattanooga, Tenn., Singleton joined Allis-Chalmers in 1926, the year he graduated from Alabama Polytechnic Institute with his mechanical engineering degree. Following student courses, he became a sales representative in the Denver district office and in 1938 was made district manager there.

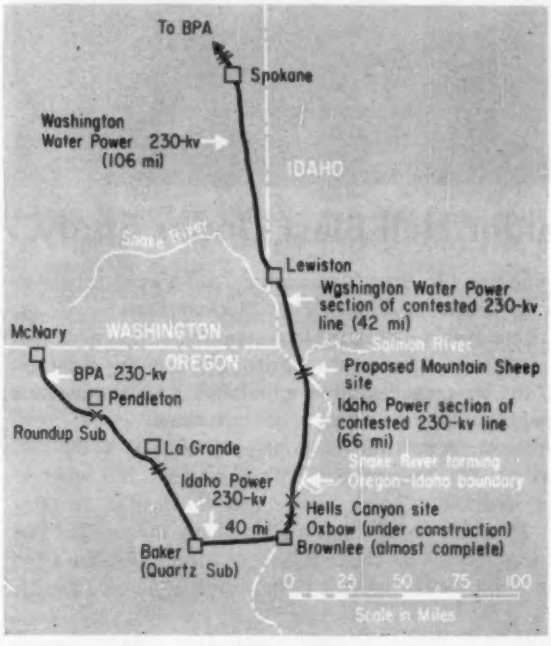
In 1942 Singleton became assistant to the steam turbine department manager. Three years later he was named manager of the general machinery division's district sales officers. He was elected vice president and director of sales for the division in 1947.

J. L. SINGLETON

Singleton was a senior vice president of the trade group before his election to the presidency.

FPC Asked to Halt Joint 230-Kv Line

The Northwest Public Power Association has filed an informal complaint asking the Federal Power Commission to halt joint construction by Idaho Power Co and Washington Water Power Co of a 230-kv transmission line from Idaho Power's Brownlee Dam to Lewiston, Idaho. Line contracts have been let and surveys completed but construction is not under way.



The NWPPA complaint said analyzer board studies made jointly by Bonneville Power Administration and Idaho Power showed that coordination of Brownlee with the Northwest Power Pool required "a shorter and much more economical line to Baker and thence to Le Grande, Ore., for interconnection with existing high lines of the federal government."

The complaint did not mention that the Brownlee-Baker-Le Grande interconnection is already in service, Idaho Power having recently completed the final Brownlee-to-Baker section. At Le Grande, the line connects with BPA's 230-kv McNary Dam-Le Grande line.

NWPPA claims construction of the 111-mi line to Lewiston violates the "coordination clause of the FPC license for Brownlee Dam." But an Idaho Power spokesman said the $7-million line will be needed for full coordination of the company's Snake River projects with the Northwest Power Pool.

The line in question actually consists of a 66-mi section by Idaho Power from Oxbow Dam site close to the proposed site of Pacific Northwest Power Co's controversial Mountain Sheep Dam. From this point Washington Water Power will build a 42-mi section to Lewiston, where it will connect to a 106-mi 230-kv line to Spokane.

BPA spokesmen said the joint studies were made to determine transmission requirements for various periods up to 1965, but not including requirements after Idaho Power's Hells Canyon Dam is completed. The studies showed, BPA said, that present transmission—not including the Lewiston line—of BPA and Idaho Power can meet coordination requirements through 1965.

BPA added that preliminary studies, including Hells Canyon, indicate additional transmission must be added for full integration between Idaho Power and the West Group of the Northwest Power Pool.

NEMA Head, W. V. O'Brien, Dies

Funeral services were held June 25 in Scarsdale, N. Y., for W. V. O'Brien, president of the National Electrical Manufacturers Association and a General Electric Co vice president.

O'Brien was elected head of NEMA at the association's annual meeting in Atlantic City in November, 1957. He had served on the board of governors since 1952, was a vice president of the trade group since 1954, and had served on numerous committees.

Associated with GE for 36 years, O'Brien was vice president and general manager of the apparatus sales division. He was in charge of sales activities for more than 50 U. S. GE departments.

W. V. O'BRIEN

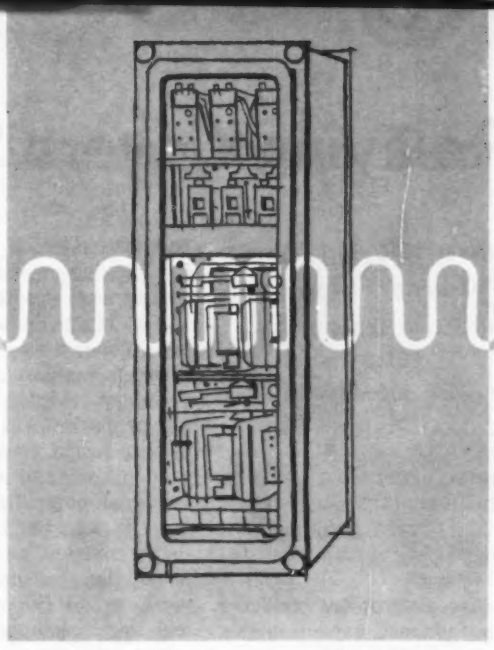
A native of West Virginia, O'Brien was graduated from Virginia Military Institute in 1922.

Long-Range Fight Seen In Coal Rate Ruling

The Interstate Commerce Commission has rejected the Southern Railway's proposed reduction in rates on shipments of coal into the Carolinas. The action marked the start of long-term aggressive action by the railroad and its customers to obtain the reductions ultimately.

The railroad will have on its side power companies in both states, the North Carolina Traffic League, and Charlotte Shippers & Manufacturers Association.

Southern's proposed cut would have saved customers as much as $6 million a year (EW, June 30, p 39). Customers feel assured though, that pending action bars any coal freight rate increase in the near future.



A SPECIAL REPORT:

New Techniques in Relaying

DAVID REA
Southeastern Editor

System expansion requires new techniques in relaying to cope with the more complex problems. There is also the continuing need to economize in the application of relays while still maintaining or improving service continuity.

Relay engineers are developing the required techniques as evidenced by the approaches of four companies in this report. Two developments involve the use of a microwave system to handle the relaying of multi-terminal lines. The third cites a means to extend the operating range of pilot-wire protection. The fourth offers an inexpensive way to protect the tertiary winding of an autotransformer.

Commonwealth Edison Co's first microwave relaying system is designed to protect a complex network of six 138-kv lines having 17 terminals. The scheme proving most economical and adaptable uses under-reaching high-speed directional phase and residual relays to transfer trip over a transistorized frequency-shift tone microwave system.

Gulf States Utilities Co uses a dc microwave relaying system of the preferred-trip type for high-speed transfer tripping of a three-terminal 138-kv line. The scheme has advantages that include better continuity, greater independence, higher speed, more freedom from interference, and greater flexibility. Featured in the scheme are the battery power supply and the testing and continuous monitoring of the complete channel availability.

Duquesne Light Co extends the operating range of its pilot-wire protection while continuing to use HCB and CPD relays. This is done by adding tuning reactors and insulating transformers and by using relays with contact back-stops.

Montana Power Co feels the tertiary winding of an autotransformer should have overcurrent relay protection. This scheme is inexpensive, simple to apply, and provides both thermal protection and back-up ground relaying.

Microwave Relaying Covers System

Commonwealth Edison's first microwave relaying system protects complex 138-kv network. Transfer tripping is selected as the most economical and effective scheme

W. E. DROEGE, Engineer, and **S. A. OLSON**, Staff Engineer, Commonwealth Edison Co, Chicago, Ill.

Microwave relaying has been adopted by Commonwealth Edison Co as most economical and superior for protecting a complex network of six 138-kv lines having 17 terminals. The relay scheme utilizes underreaching high-speed directional phase and residual relays in a transfer-trip arrangement operating over a transistorized frequency-shift tone microwave system.

This is the first microwave relaying on Commonwealth Edison's system, where power-line carrier and pilot-wire relaying were used previously. Of the 53 138-kv lines on the system, power-line carrier has been applied to 16 multi-terminal and 24 two-terminal lines. Remaining lines are protected with pilot-wire differential relaying.

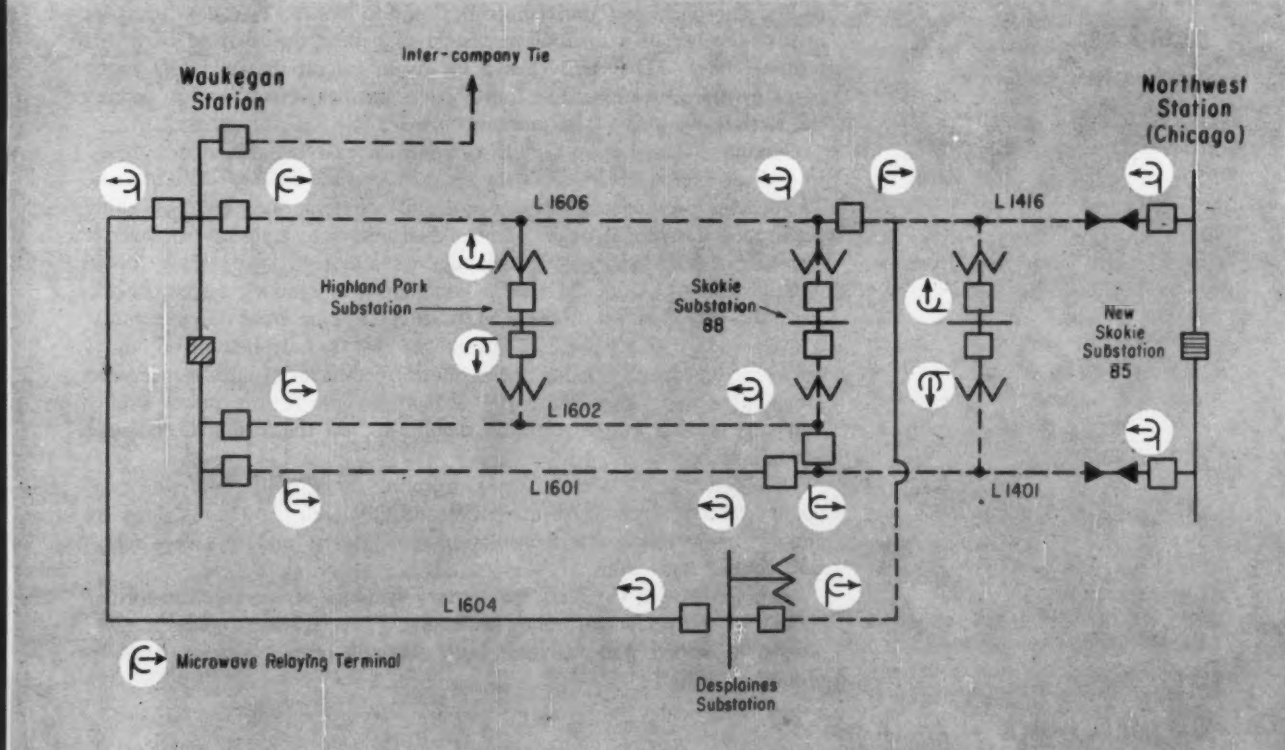
Need for microwave relaying stems from planned expansion this year of three 138-kv lines to six 138-kv lines with 17 terminals in the area between Waukegan and Chicago. Relaying of the lines is complicated by design of the transmission system so as to minimize costs while maintaining a high level of service continuity. Complicating factors include use of multi-terminal and double-circuit lines, automatic line reclosing, connection of power transformers without individual 138-kv circuit breakers, and use of one sectionalizing circuit breaker between two line taps.

Studies revealed that service continuity problems arising from this system design could not be solved economically and reliably with conventional power-line carrier relaying. It was, therefore, concluded that a complete microwave relaying installation for this complex network would be more economical and superior to power-line carrier schemes because:

1. In a congested area, with many line terminals, cost of adding powerline carrier increases directly with the number of terminals. Incremental cost of adding microwave terminals is substantially less.

2. Absence of 138-kv transformer circuit breakers and inclu-

REMOTE TRIPPING at numerous locations on the 138-kv transmission network is required to maintain the desired standard of service continuity. Transfer-tripping by microwave was selected as the best and most economical scheme



of 6 Lines with 17 Terminals

sion of line taps require protection of the multi-terminal lines. This can be done by making the local terminal relays trip both the local breakers and the associated remote breakers for line and transformer faults. The numerous remote tripping functions exceeded the dependable capability of power-line carrier, but they could be accomplished with microwave without overcrowding the available frequency spectrum.

3. Microwave channels are physically divorced from the line conductors. Consequently, line faults, switching requirements, and storm effects do not impair transmission by microwave channels.

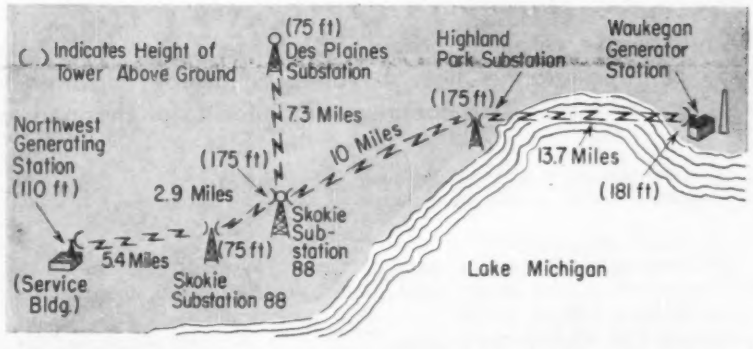
4. A microwave system in a high-density area can be expanded economically and readily to include additional channels for relaying, supervisory control, telemetering, and voice communication.

Microwave facilities were installed to provide the relaying functions shown in the accompanying listing, plus voice, control, and telemetering functions. The short line-of-sight routes chosen for microwave channels were confirmed by field survey. Microwave transmission among the six terminals is in the 2,000-Mc band. The longest single route, Waukegan to Highland Park, is only 13.7 miles, with about half this distance over Lake Michigan. Pre-service tests showed no serious fading of the microwave channel from water reflections.

Uses Transistors, Tone Shift

One feature of the microwave equipment is the use of frequency-shift tone components using transistors. For relaying of 17 line terminals, 34 transmitters and 68 receivers will be used in a dual-tone, transfer-trip arrangement controlled by underreaching, high-speed, directional phase and residual relays.

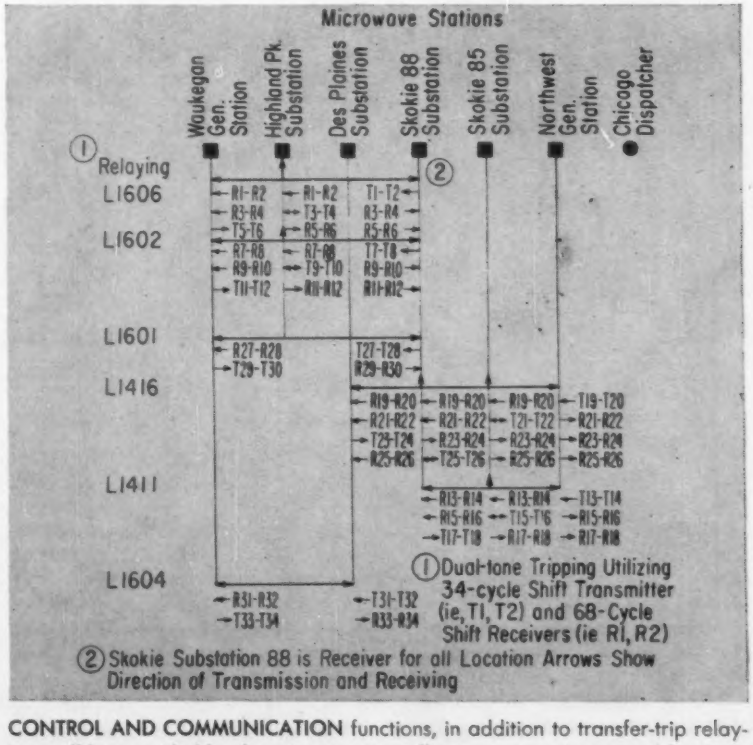
Each location has complete automatic microwave radio stand-by equipment. The radio system has a remote-fault analyzing system to warn of failures and show their



LINE-OF-SIGHT microwave channels were confirmed by field survey. Pre-service tests of the over-the-water route showed no serious fading of the signal

locations at some centralized point.

Power supply for microwave terminals is an ac motor-ac generator set which has a large flywheel. The set normally is supplied by the station auxiliary power source, with an emergency service from a propane-driven engine through a magnetic clutch on the same shaft. Four of the six transmission lines have been placed in service with the microwave transfer-trip relaying arrangement. Remaining lines will go in service soon, and telemetering and other microwave intelligence will be installed subsequently.



CONTROL AND COMMUNICATION functions, in addition to transfer-trip relaying, will be provided by the microwave installation among six terminal locations

Dc Microwave Protects 3-Terminal

Dc microwave relaying provides high-speed transfer tripping of three-terminal line. Advantages include a battery supply, and testing and continuous monitoring of channels

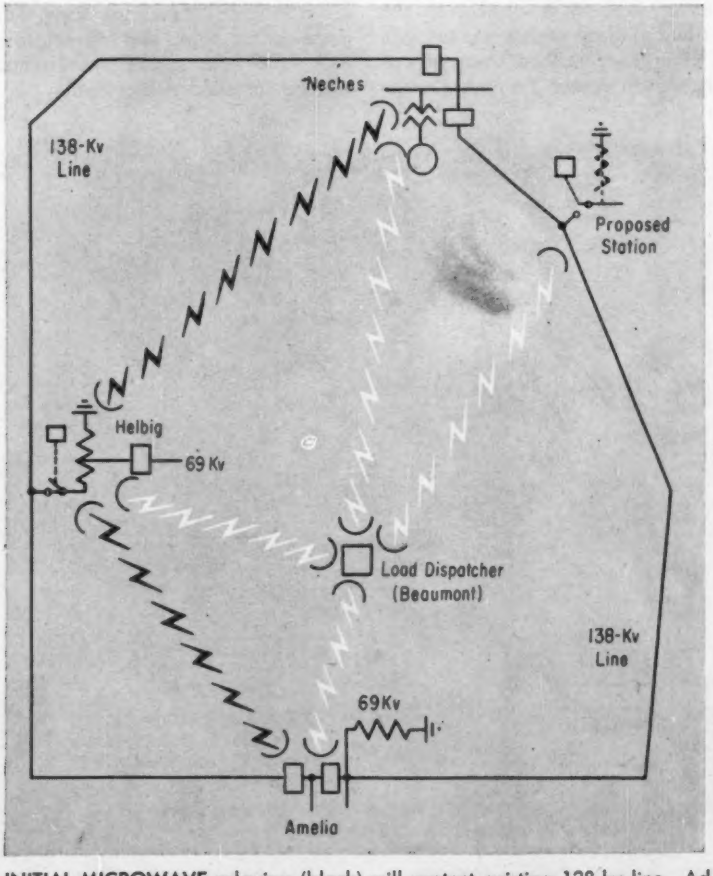
J. O. ROBICHAU and F. S. ROBY, Relay and Communication Engineers, Gulf States Utilities Co, Beaumont, Tex.

Microwave relaying will protect a three-terminal line using high-speed transfer tripping of the preferred-trip type. Gulf States Utilities Co has found the many advantages of this tone-channel relaying system justify the small additional cost. Among the advantages are better continuity, greater independence of the power system, faster operation, more freedom from interference, and more flexibility.

Several of these advantages are enhanced by novel features included in the equipment. These are: use of batteries to supply power for the important functions and ability to test and continuously monitor availability of the complete channel. The test and monitoring schemes will operate from the load dispatcher's office. Should a failure occur, the load dispatcher is warned automatically.

Microwave is being applied to a 138-kv three-terminal line having two sections, each of which is about 12 miles long. Paralleling this line, but on another right-of-way, is a two-terminal line that probably will be tapped in the future. This expected tap and the use of a high-side motor-operated switch at the tapped substation, instead of an oil circuit breaker complicate the relaying problem.

On the 138-kv system, 3-phase and ground faults will be 5,000 to 10,000 amps. Thus, to adequately protect transformers and minimize system disturbances, transfer tripping with a minimum of clearing time is needed. For line faults, conventional relaying methods were slow of necessity because the large ground source for faults at the tapped transformer (Helbig substation) could cause sequential operation of breakers.



INITIAL MICROWAVE relaying (black) will protect existing 138-kv line. Additional routes (while) will expand the system to a hub layout

Fast Clearing Is Aim

For high-speed protection, schemes had to be designed to provide transfer tripping for both transformer faults and to clear line faults. The problem was basically one of communicating information among all terminals to trip them nearly simultaneously.

Of the communication mediums available, two power-line carrier schemes and a 960-Mc microwave system were studied. Company-owned pilot wire cost to much.

One carrier scheme consisted of conventional carrier blocking on both the two and three-terminal lines. For the latter line, transfer tripping was included to trip the Amelia and Neches breakers for a transformer fault at Helbig. The

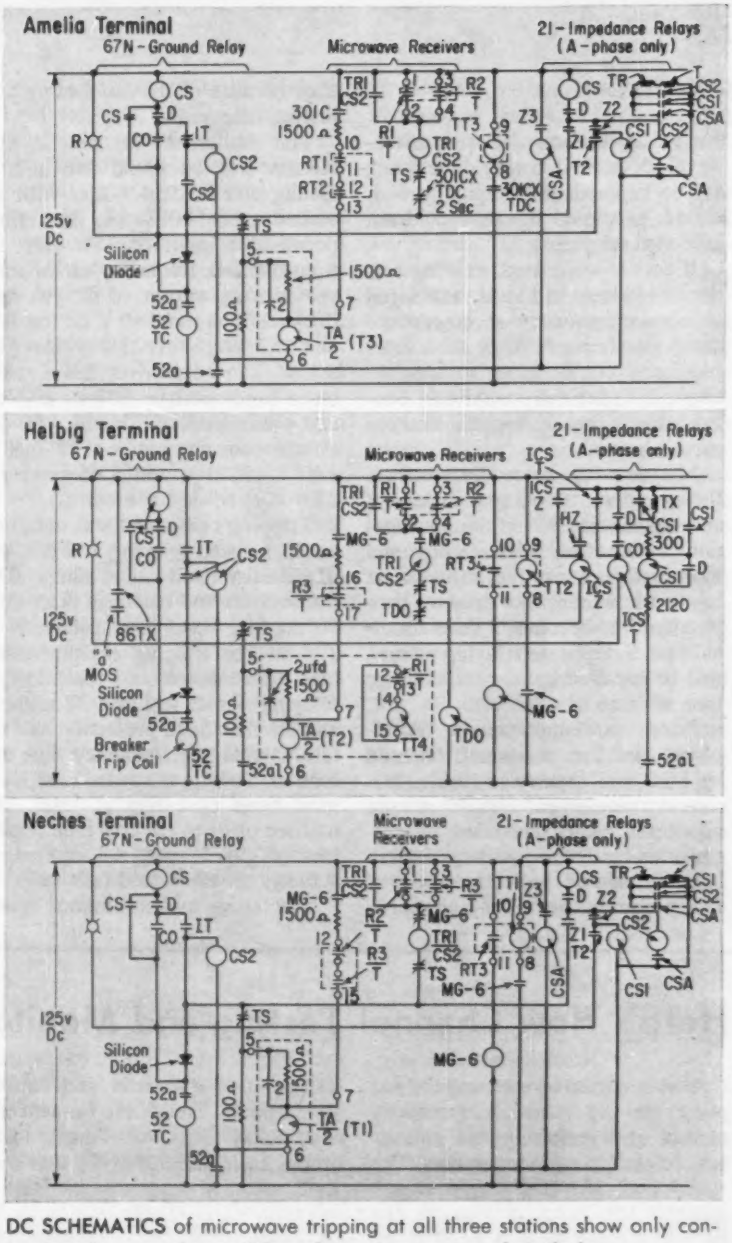
Adapted from a paper presented at the Texas A&M College 11th Annual Conference for Protective Relay Engineers.

Circuit

other carrier scheme would use a less-reliable and less-expensive direct underreaching transfer-tripping scheme on the three-terminal line and a conventional blocking scheme for the other line. All transfer-tripping schemes were to have equipment to allow daily checks of relaying channels from one terminal by supervisory control.

These carrier schemes were compared with transfer tripping over a dc microwave system utilizing direct underreaching or first zone overlap. With first zone overlap, the instantaneous elements of each terminal are set to extend into the first zone of the other terminals. In the comparison, major factors considered were: Cost, continuity of channel, independence of power system, speed of operation, freedom from interference, flexibility, and maintenance.

From the initial cost standpoint, microwave was about 75% of that for one carrier scheme and 10% greater than the other. However, microwave removes the undesirable features of using direct underreaching relaying by carrier. Also, the overall operation of relaying and checking was simpler, enhancing microwave's reliability.



DC SCHEMATICS of microwave tripping at all three stations show only connections for one phase. Other phases are connected similarly

Continuity Is Adequate

Continuity of a microwave channel for transfer trip is better because propagation is independent of the physical condition of 138-kv lines. To make a direct comparison of both schemes, it must be assumed that carrier will work through a fault. Although not important for conventional carrier blocking, the assumption is significant in the direct tripping schemes. Direct tripping is desirable to speed clearing and for simplicity.

The chance of channel interruption due to component failure is less for microwave because power supplies and tone equipment are transistorized. Also, no channel interruptions due to path propagation problems are expected, based on experience under similar conditions using the same manufacturer's 960-Mc equipment.

The microwave system selected provides additional independence because it is supplied from batteries. This feature is important because it eliminates undesirable rotating or switchover equipment, which cause many failures. A 130-v station battery is used, with very low drain, and without intentionally grounding one side. An additional 24-v batter supplies filament or heater voltage and a transistorized power supply for the r-f equipment plate voltage. Auxiliary functions of testing tone equipment and voice channeling are connected to the ac station service to avoid battery drain.

Another factor favoring microwave is speed of operation. Microwave channeling will introduce less than a cycle of delay between the energizing of the local trip circuit and energizing of both remote trip circuits. Freedom from interference

was a decisive factor favoring microwave. Because it is very directional, narrow beamed, and frequency modulated, unwanted signals should not influence relaying.

If carrier were used, existing carrier would have had to be rearranged to obtain frequency spectrum and avoid interference. Also, the carrier required would have to operate above 200 kc; this would add considerable expense besides limiting carrier expansion.

Microwave is more flexible from the standpoints of rearrangement and expansion. Additional functions of control, telemetering, and more relaying can be included at low cost. When the present two-terminal line becomes a three-terminal line, a duplicate relaying scheme will be installed in very little outage time with no obsolence.

From the maintenance standpoint, qualified personnel, licensed by FCC, are already available. Microwave equipment should require about the same scheduled maintenance as carrier and perhaps less on a nonscheduled basis. Isolation of faulty equipment will require little time because of the monitoring and testing schemes.

The equipment at Amelia and Neches will be 958.5 Mc and at Helbig will be 954.9 Mc, with an emission of 500F9 and maximum permissible input of 3 w. The r-f transmitter is frequency modulated, provides an output of 0.5 w, and draws 175 ma at 140 v dc for B+ and 1.2 amps at 23.8 v for filaments. The r-f receiver has a minimum band width of 650 kc at 3 db and a maximum of 3 Mc at —60 db. Power consumption is 175 ma at 140 v for B+ and 1.65 amps at 23.8 v ac or dc for filaments.

Tripping equipment was designed for high-speed relaying and consists of transistorized tone units. The transmitters and receivers draw only 50 ma and 100 ma, respectively, at 128 v. The tripping equipment allows transmission and reception of relaying signals within 8-12 millisec and affords added protection against false tripping by frequency shift operation. To trip, the guard tone must have been operating at least 200 millisec prior to the trip tone. Upon loss of guard tone, the equipment actuates an alarm and fails safe.

The testing and continuous monitoring scheme is operated from a single location in the load dispatcher's office. Separate supervisory equipment on wire line is installed to control Helbig and Amelia stations. If a transmitter fails, the dispatcher will be warned immediately and can readily determine the substation involved. Operation of the microwave relay scheme is described below.

Functioning of the protective relaying scheme is shown in the tripping diagrams for the three stations. At Amelia, tripping action of zones 1 and 2 are distinctly different. For a fault in zone 2, with or without microwave, the tripping sequence is conventional, as is tripping of the overcurrent unit of the ground relay. When the CO element operates, the seal-in contact around the instantaneous trip of the ground relay is broken to prevent transmission of a trip signal to the other terminals.

At all three terminals, zone 1 trips the local breaker and initiates the trip signal to the remote terminals for transfer tripping. The instantaneous element of the ground relay also initiates a transfer-trip signal.

Instead of using an auxiliary relay

Here's How Channel Testing and Monitoring Operates

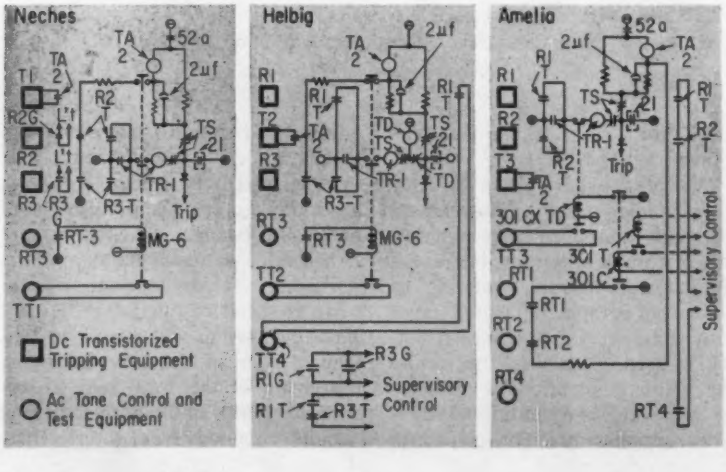
Test is started by selecting the test point on the Amelia supervisory control and performing an equivalent "close" breaker operation. The test point is a control and supervision point. Here's the sequence:

1. Relay 301C at Amelia sets up the keying circuit of T3 that will be completed when receivers RT1 and RT2 receive their respective tones. Relay 301C also energizes relay 301CX(TD), which has 2.0-sec time-delay on drop-out. The 301CX(TD) contacts open the local trip circuit and key TT3.

2. Receipt of TT3 signal at Helbig and Neches by RT3 energizes MG-6 auxiliary relays, whose contacts open the trip circuit at each station. Relay MG-6 at Neches will key TT1 and set up the keying circuit of T1. Relay MG-6 at Helbig will key TT2 and set up the keying circuit of T2.

3. Receipt of TT1 and TT2 signals at Amelia by RT1 and RT2 completes the keying circuit of T3, which initiates transmission of trip frequency signal.

4. Receipt of T3 signal at Helbig by R3 completes the keying cir-



contact to energize TA/2 to shift, transmitter frequency from guard to trip signal, a silicon diode rectifier of high capacity is used directly in the trip circuit. This diode will allow the shift to trip frequency about one-half cycle faster. Also, it effectively isolates the ground-relay overcurrent element and the impedance-relay zone 2 element from the transmitter keying circuit.

Transmission of trip signal at Neches and Amelia is interrupted by the breaker opening with a 52a contact. With a 3-cycle breaker, this means that a signal for transfer tripping will be on for only 3 cycles. Because the microwave channel time is 8 to 12 millisec, there is time to trip the remote terminals. The receiver tripping circuit is sealed-in after energizing TR1.

Reception of the trip signal at a remote terminal closes either or both of the receiver contacts, R1 and R2, at Amelia. Closure of these contacts, with all normally closed contacts made, will energize the trip coil. The 85/S1 (TR1) relay that seals-in the receiver contacts carries the heavy current required for the trip coil. At the same time, this station initiates and transmits a trip signal until the breaker opens.

For example, assume that a fault occurs near Amelia and that its relays act to trip the local breaker and to initiate trip signal to the remote terminals. Assume further that the R3 receiver at Helbig, which should normally receive the T3 signal, is not operating. Under these conditions, the Neches receiver R3, upon reception of T2 from Amelia, will trip the Neches breaker and initiate a trip signal on T1 frequency. Helbig terminal would then trip from R1 receiver, clearing the faulted line. Therefore, correct high-speed protection is achieved with various combinations of receiver equipments out of service.

Tripping schematic for Helbig is similar to Amelia terminal with one exception. For relaying during a transformer fault, the trip signal is transmitted until the motor-operated switch opens in 2-5 sec, even though the fault is cleared when the breakers open. The motor-operated switch contact is used to interrupt the trip signal transmission because:

1. With the breaker on the 69-kv side open, the transformer ground paths is still completed.

2. With the transformer out of service and the 69-kv breaker open, channel testing can still be accomplished.

3. The transmission time of tripping signal from this terminal will be longer than from the other terminals.

Should the microwave fail, the opening of the motor-operated switch for a transformer fault should draw an arc large enough to flash over phase-to-phase or phase-to-ground. The resulting fault would be cleared from remote terminals by impedance or ground relays. Although this relaying method is not accurate, it should prevent extreme damage to the transformer.

The Neches terminal schematic is similar to the Amelia terminal except that a test receiver opens the trip circuit during testing.

This microwave system should trip all breakers by transfer trip within 6½ cycles from the time the first trip coil is energized by the fault-detecting relay. This time includes one 5-cycle and two 3-cycle breakers. If carrier were used with either phase or directional comparison schemes, the total time would be about 10 cycles.

cuit of T2, initiating trip frequency signal.

5. At Neches, the simultaneous reception of T3 and T2, by R3 and R2, with their relay contacts in series, completes the keying circuit of T1, initiating trip frequency signal from this station.

6. Receipt of T1 at Helbig by R1 keys TT4.

7. With simultaneous reception at Amelia of T1 from Neches and T2 and TT4 from Helbig, by receivers R1, R2 and RT4, the receiver contacts in series will complete the supervision circuit on the test point of the supervisory control. This indicates that all equipment at each terminal is operating, by virtue of the inter-locking arrangement.

To restore the system to normal, the test point again is selected, and an equivalent "trip" breaker operation is performed. Then this sequence of events occurs:

Relay 301T at Amelia is energized, which de-energizes relay 301C. A 301C contact breaks the keying circuit of T3 and stops transmission of trip frequency. This acts to break the system of inter-locking both at Helbig and Neches terminals, stopping the transmission of all trip frequency signals. Also, relay 301T at Amelia de-energizes the time-delay relay 301CX(TD), which in 2.0 sec restores the local trip circuit to normal and breaks the keying circuit of TT3. Stopping transmission of TT3 signal then breaks the interlocked system of the control tone units and restores them to their normal "off" condition at each terminal.

If a disagreement indication is received at the end of step 7, indicating that some equipment is not operating, the load dispatcher can observe the loss-of-guard-frequency supervision on the Amelia and Helbig control equipments. By comparing this with a similar observation by the control-room operator at Neches, the trouble can be isolated in practically all cases.

Constant monitoring is achieved by two standard supervision points on the Helbig supervisory and a standard supervision point on the Amelia supervisory. At each terminal, the receiver relay that operates on loss-of-guard frequency is supervised. At Neches, this supervision is accomplished by lamp indication.

This monitoring scheme warns the load dispatcher of the loss of any tripping channel equipment except the two receivers at Neches. But this is unimportant because this system provides correct high-speed relaying as long as the three transmitters, T1, T2 and T3, are operating and any one of the receivers, R1, R2 and R3, at each terminal is operating. Thus, the load dispatcher will know immediately when a transmitter fails and at which station.

Extend Pilot-Wire Relay Range

Reduce circuit capacitance with tuning reactors and by varying transformer ratio. Line length is limited by resistance

C. M. JACKSON, Relay Engineer, and W. J. CALLIN, Project Engineer, Duquesne Light Co, Pittsburgh, Pa.

Operating range of pilot-wire protection can be extended so that relays will function properly on telephone pairs whose constants exceed generally-accepted limits. This conclusion is based on extensive laboratory tests and several field installations made by Duquesne Light Co. Extended-range pilot-wire operation is applicable to parallel transmission lines, with four of the five lines now so protected being in parallel.

To increase the range of operation, using either HCB or CPD relays, Duquesne Light suggests that:

1. Sensitivity may be improved 15-20% with tuning reactors.

2. For HCB equipment, 4/1 insulating transformers should be used on long circuits of 19-gage wire or larger, using relays with contact back stops on long pairs.

3. For CPD equipment, in addition to using tuning reactors, insulating transformer ratio must be changed to decrease the apparent capacitance of extremely long pairs.

4. Each installation must be field tested to determine optimum tuning.

The company-owned telephone line protective system includes 113 two-terminal and eight three-terminal pilot-wire installations for high-speed protection of lines from 138 kv down to 11.5 kv. In general, 18 or 19-gage wire is used for all circuits; carbon blocks or protective gaps are not used on pairs. On most new installations, neutralizing transformers and protective tubes are used.

To continue using HCB or CPD relays, as power-line expansion prompted extension of relay operating ranges, it became obvious that limitations of telephone circuit constants of 2,000 ohm (maximum loop impedance) and 1.5μ (maximum distributed capacitance) would have to be overcome. It appeared more desirable to extend the operating range of pilot-wire equipment than to adopt new relaying schemes.

Because Duquesne Light owns the telephone system, resistance limitations of longer pilot-wire circuits could have been overcome by increasing wire size. However, economics ruled out this approach immediately; increased wire size also would aggravate the capacitance problem. To neutralize line capacitance, tuning reactors could be connected across each end of the pair. With capacitance neutralized, resistance then would determine usable circuit length. Maximum lengths of pilot-wire circuits then would be 22.7 miles for 19-gage wire, 29.4 miles for 18-gage, and 47.5 miles for 16-gage.

Test Actual Lines

Circuit length also may be increased by changing the insulating transformer ratio to vary pair resistance and capacitance as seen by the relay. However, as transformer ratio is changed to decrease resistance, capacitance increases; as the ratio is varied to decrease capacitance, resistance increases. Because analytical evaluation of transformer ratio variation would have been difficult, a better solution was testing of pilot-wire installations.

Laboratory experiments were initiated to determine the effects of shunt tuning reactors and varying the insulating transformer ratios on the operation of longer pilot-wire installations. Two complete pilot-wire terminals of both HCB and CPD equipment, including insulating and neutralizing transformers and supervisory equipment were provided. When it was found that the supervisory equipment, had no effect on initial results, it was removed from the set-up.

For HCB tests, both 4/1 and 6/1 insulating transformers were used initially. For CPD tests, a second insulating transformer, connected as an autotransformer, was inserted in each terminal between the relay and the 1/1 two-winding transformer. Effective insulating transformer ratios of 2/1, 3/2, and 4/3, either step-up or step-down, were obtained. By connecting two telephone pairs between the test laboratory and Duquesne Light's telephone office, telephone pairs of varying lengths were provided.

The 700-ohm and 1,700-ohm test pairs provided data for pairs of normal length. The 2,700-ohm and 3,700-ohm test pairs indicated how far pilot-wire operating range might be increased. Tuning reactors were connected across the pair between the neutralizing and insulating transformers. For comparative testing, a variable-current source was applied to the two relays in series. Internal and external faults were simulated by reversing the current in one relay. Data were obtained for both phase-to-phase and phase-to-neutral faults.

A series of curves of relay pick-up vs effective line capacitance were run, with both single-end and double-end feed conditions simulated. At each point on the curve, a high-magnitude external fault was applied to detect the point of incorrect relay operation. When proper tuning for most efficient relay operation was determined, an external-fault operating curve was run to insure that relays blocked correctly for all through-faults.

In testing the HCB relays, settings of $T = 4$, $R_1 = 0.075$, $R_0 = 1.6$, and $T = 4$, $R_1 = 0.15$, $R_0 = 1.6$ were used. Curves of sensitivity vs effective-pair- capacitance all had a shape similar to those in Fig. 1. As tuning was added, relay sensitivity increased to a maximum at an equivalent line capacitance of 0.4-0.6 μf, then decreased with further tuning.

Use of 6/1 insulating transform-

Based on a paper presented by the authors before the Relay Committee of the Pennsylvania Electric Association.

ers proved impractical on the long test pairs. With 4/1 insulating transformers, the relay operated properly on 2,700-ohm and 3,700-ohm pairs, with about 15% improvement in sensitivity through tuning. Maximum sensitivities, using settings of $T = 4$, $R_1 = 0.15$, $R_0 = 1.6$, are given in Fig. 2.

A phase-to-phase pickup of 15.5 amp (3,700-ohm pair, single-end feed) is too high to be practicable in most cases. An auxiliary CT network, inserted in the CT leads feeding the HCB relay, will improve phases A-B and A-C sensitivity some 40% and B-C sensitivity about 67%.

Curves in Fig 2 do not reflect the increase in sensitivity provided by the auxiliary CT network. They are valid only for 19-gage, paper-lead telephone cable and are not criteria for all pilot-wire circuits. Through-fault operating curves for 2,700-ohm and 3,700-ohm pairs are shown in Fig 3, with a curve for the 1,700-ohm pair for comparison. As all curves lie well below the 45-deg line, there is no risk of false operation on external faults.

False Operation Unlikely

In testing the CPD relay, shape of the sensitivity vs capacitance curves differed markedly from those for the HCB. As shown in Fig. 4, relay sensitivity continually increased with tuning. Because pickup decreased continually, optimum tuning could not be determined from the sensitivity curve. However, a plot of the ratio of relay-operating-coil currents for inside to outside faults vs effective line capacitance produced a peaking curve. It was presumed the peak indicates tuning for best operation. Curves are shown in Fig 5 for the 3,700-ohm pair.

On the 3,700-ohm pair with a 1/1 insulating transformer, the relay operated on external faults regardless of the value of tuning. The ratio had to be varied to 4/3 (step-down to the pair) to obtain proper operation. As seen by the relay, the 4/3 ratio produces effective pair constants of 6,580-ohm resistance and 1.4-μf capacitance. Proper operation also may be obtained using a 3/2 ratio, which gives effective pair constants of 8,320 ohm and 1.1 μf. However, relay sensitivity is low in this case.

With a 4/3 insulating trans-

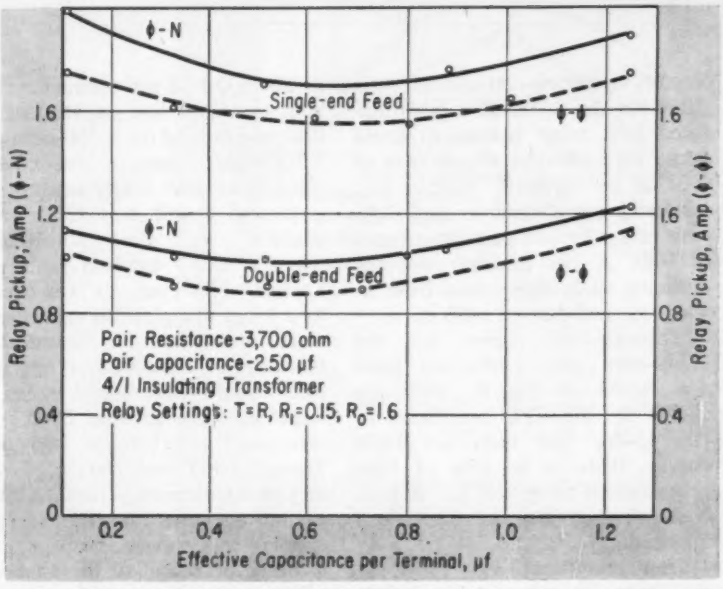


FIG 1—EFFECTIVE CAPACITANCE of test pair varied to obtain relation with sensitivity of HCB relay. Shape of curves in all HCB tests was the same

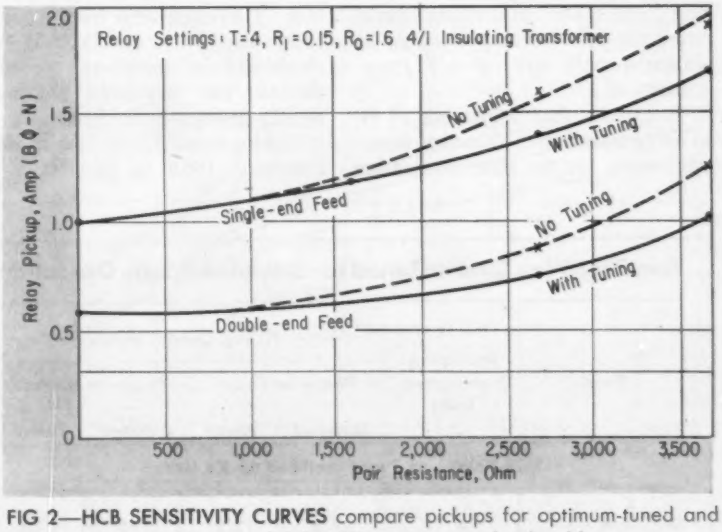


FIG 2—HCB SENSITIVITY CURVES compare pickups for optimum-tuned and untuned circuits. Curves valid for 19-gage, paper-lead cable

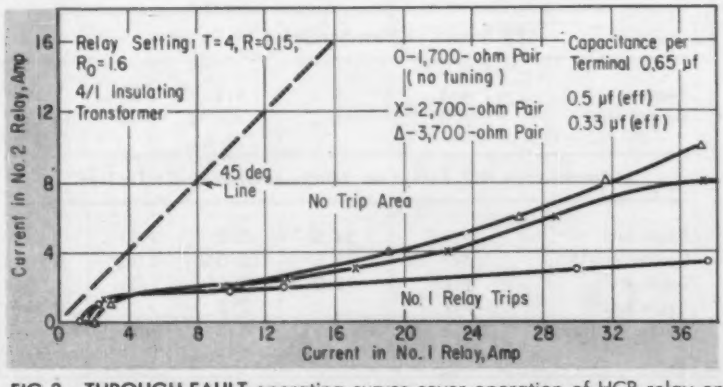


FIG 3—THROUGH-FAULT operating curves cover operation of HCB relay on a B phase-neutral fault with test pairs tuned for optimum operation

former, operating-coil-current ratio curve for the 3,700-ohm pair indicated best relay operation would occur with effective capacitance of 0.62 μf per terminal. With a 1/1 insulating transformer on the 2,700-ohm pair, effective pair capacitance of 0.41 μf per terminal was the optimum value determined from an operating-coil-current ratio curve.

Through-fault curves for the 2,700-ohm and 3,700-ohm pairs are shown in Fig 6. Although curves for the CPD are closer to the 45-deg line than are HCB curves, there is no risk of false operation so long as CT's at both ends of the line are fairly well matched.

How relay sensitivity varied as the pair resistance increased is shown in Fig 7 with curves for the 1/1 insulated transformer. Proper relay operation on external faults using the 3,700-ohm pair could be obtained only with a 4/3 transformer.

It appears that inductance of insulating transformer furnishes inherent tuning for the pairs amounting to about 0.3 μf per terminal. Thus with optimum line capacitance of 0.41 and 0.62 μf for 2,700-ohm and 3,700-ohm pairs, respectively, capacitance was nearly neutralized.

It was found that CPD relay contacts would close momentarily when a heavy external fault was applied. This evidently was caused by a surge charging the capacitance of the long pairs. But the effect of this extremely short-duration transsient could be eliminated by an interposing relay between CPD contacts and the breaker trip coil. Though CPD contacts closed, the surge was dissipated before the interposing relay could operate, so false tripping was prevented.

Based on results of these laboratory tests, five circuits, three of HCB equipment and two of CPD, have been fitted with shunt tuning reactors. Thorough field tests included relay sensitivity checks for both single-end and double-end feed conditions, and simulated high-magnitude through-fault checks.

Tuning installations were made in February, 1956 on two HCB circuits protecting two paralleled 69-kv lines. Telephone pairs had 2,600-ohm resistance (including neutralizing transformers) and 2.1-μf capacitance. Tuning 15-h reactors in series with 10-μf capacitors were connected across end of the pairs between neutralizing and insulating transformers. They produced effective pair capacitance of about 0.5 μf per terminal. Average relay sensitivities, with and without tuning, are listed in the table.

Since tuning was installed, five faults occurred on one line and three faults on the other. In each case, only the faulted line was cleared by the HCB protection. Though many through-fault currents have flowed in these lines from faults on nearby lines, HCB relays have never operated incorrectly.

In July 1956, reactor tuning was installed on two CPD circuits on another pair of paralleled 69-kv lines. Telephone pairs had constants of 2,500-ohm resistance (including neutralizing transformers) and 2.33-μf capacitance. Tuning 12-h reactors in series with 10-μf capacitors produced effective pair capacitance of about 0.5 μf. An interposing relay was installed in the trip circuit of each CPD. Average relay sensitivities obtained also are listed.

Before tuning was installed, there was one false tripping of the CPD on a through-fault on one of the lines. Since the installation, there have been several faults on nearby lines, but the CPD relays have not operated incorrectly. One single-circuit fault on each line, and two faults involving both lines were cleared properly by the relays.

Another tuning installation required extensive testing to obtain proper operation. This was a 69-kv interconnection to a neighboring company protected by a joint HCB installation over a rented telephone line. The pilot-wire circuit had 2,250-ohm resistance and 1.6-μf capacitance, with three-winding neutralizing transformers and 6/1 insulating transformers at each terminal. In September, 1954, it was tuned with 15.5-h reactors in series with 10-μf capacitors across each end of the pair. Tuning decreased effective pair capacitance to about

Five Pilot-Wire Circuits Tuned for Extended-Range Operation

Feed	Insulating Transformer Ratio	Pickup Current, Amp			
		Phase-to-Phase		Phase-to-Neutral	
		Untuned	Tuned	Untuned	Tuned
HCB Relays on Two Paralleled 69-Kv Lines					
Single end	4/1	14.8	12.2	1.65	1.38
Double end	4/1	7.9	6.6	0.88	0.71
CPD Relays on Two Paralleled 69-Kv Lines					
Single end	4/3	8.2	6.5	1.78	1.42
Double end	4/3	5.5	4.8	1.20	1.05
Newer-style HCB Relays on Jointly-relayed 69-Kv Tie Line					
Single end	6/1	24.5	10.6	2.50	1.01
Double end(1)	6/1	13.0*	6.0*	1.30*	0.60*
Single end	4/1	12.0	12.0*	1.00	1.20*
Single end**	4/1	....	7.6	....	0.80*
Double end(2)	4/1	5.5	5.6	0.55	0.60

(1) Relay operation on through-fault was incorrect. (2) Relay blocked correctly on through-fault. * Estimated value. ** Feed from D. L. terminal, pilot-wire open at other terminal.

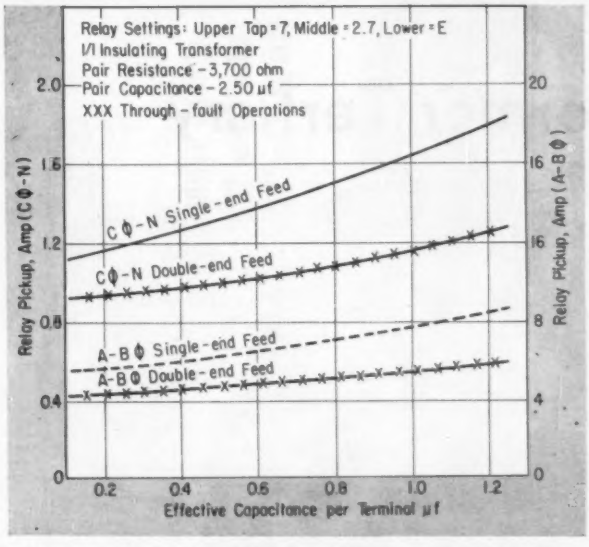

Relay Settings: Upper Tap = 7, Middle = 2.7, Lower = E
I/I Insulating Transformer
Pair Resistance – 3,700 ohm
Pair Capacitance – 2.50 μf
XXX Through – fault Operations
CΦ-N Single-end Feed
CΦ-N Double-end Feed
A-BΦ Single-end Feed
A-BΦ Double-end Feed
Relay Pickup, Amp (CΦ-N)
Relay Pickup, Amp (A-BΦ)
Effective Capacitance per Terminal μf

FIG 4—EFFECTIVE CAPACITANCE of pair vs CPD pickup reveals optimum tuning not found from sensitivity curve

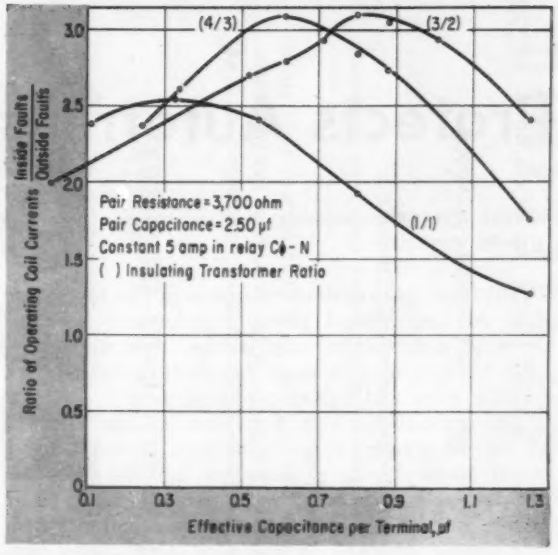

(4/3)
(3/2)
(1/1)
Pair Resistance = 3,700 ohm
Pair Capacitance = 2.50 μf
Constant 5 amp in relay CΦ-N
( ) Insulating Transformer Ratio
Ratio of Operating Coil Currents Inside Faults / Outside Faults
Effective Capacitance per Terminal, μf

FIG 5—PEAKING CURVES were used to indicate the proper tuning for most efficient operation of the CPD relay

0.35 μf per terminal and improved sensitivity by 60%.

In November, 1956, the other end of the 69-kv tie was moved to a new substation, extending the pilot-wire circuit. Resistance was increased to 2,700 ohm, while capacitance remained at 1.6 μf. It was necessary to insure proper through-fault blocking, while obtaining high sensitivity because of the low fault current available from Duquesne Light's terminal.

Sensitivity requirements were readily met by using the most sensitive relay setting (T=4, R_1=0.15, R_0=1.6), and by adjusting the relays to pick-up on less than normal current. Sensitivities for this circuit are shown in the table. However, considerable difficulty was experienced in preventing the relays from operating incorrectly on external faults. Tests showed proper operation could be obtained by:

1. Replacing the 6/1 insulating transformers with 4/1 transformers.

2. Replacing older-style HCB relays with newer relays having contact back stops and improved magnetic circuits.

3. Neutralizing nearly all pair capacitance, even at some sacrifice in sensitivity. Tuning for proper operation, about 10 h at each terminal, gave an effective pair capacitance of 0.08 μf per terminal. The reason for this disagreement with laboratory tests and field installations has not been determined.

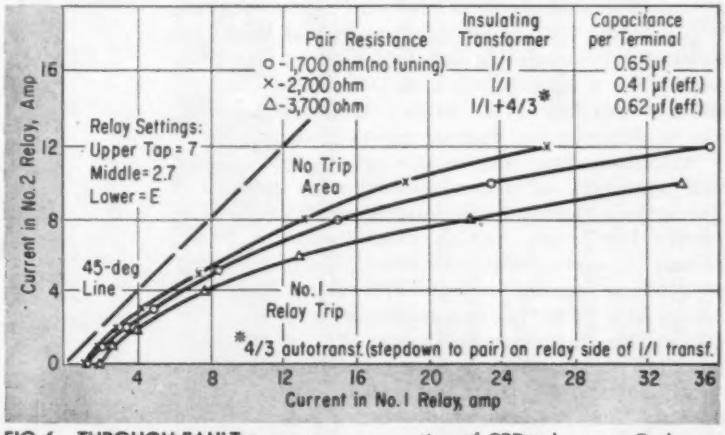

Pair Resistance
Insulating Transformer
Capacitance per Terminal
○ - 1,700 ohm (no tuning) — I/I — 0.65 μf
× - 2,700 ohm — I/I — 0.41 μf (eff.)
△ - 3,700 ohm — I/I + 4/3* — 0.62 μf (eff.)
Relay Settings:
Upper Tap = 7
Middle = 2.7
Lower = E
No Trip Area
45-deg Line
No. 1 Relay Trip
*4/3 autotransf. (stepdown to pair) on relay side of I/I transf.
Current in No. 2 Relay, Amp
Current in No. 1 Relay, amp

FIG 6—THROUGH-FAULT curves cover operation of CPD relay or a C phase-neutral fault with tuned long pairs. Close matching of CT's prevents error

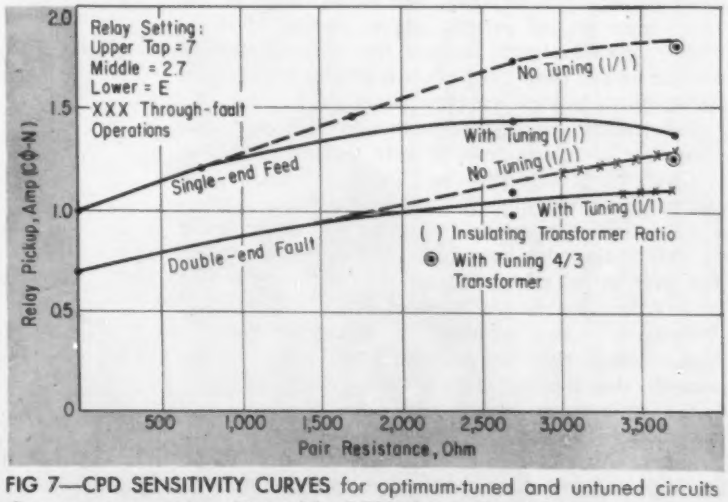


FIG 7—CPD SENSITIVITY CURVES for optimum-tuned and untuned circuits show proper operation obtained for 3,700 ohms with a 4/3 transformer

Protects Autotransformer Tertiary

ROBERT J. LABRIE, Substation Engineer, Montana Power Co, Butte, Mont.

Although autotransformers represent less investment than do conventional power transformers for step-down to a subtransmission voltage, their application calls for special provisions for short-circuit stresses, and for relay and lightning protection.

The conventional unit, if it has a leakage reactance of 4% or greater, is self-protecting. Internal mechanical forces due to a secondary terminal fault will not destroy it, even were its primary connected to an infinite bus. But each winding of an autotransformer is normally designed to withstand short-circuit currents 25 times rated current. As short circuit currents can exceed this value, an autotransformer must not be applied to a bus having a greater capacity available.

Usually autotransformers have a delta-connected tertiary winding for neutral stabilization and third-harmonic suppression. If it does not supply a load, the tertiary has a capacity of about 33% of the series or common winding. The tertiary short-circuit rating can be exceeded for external line-to-ground faults.

Autotransformers may require tertiary-winding thermal protection, as well as normal relay protection. The tertiary thermal rating usually is 25 times rated current for 2 sec. During external ground faults, tertiary per-unit current can exceed 33% of the series or common winding current. The tertiary in Fig 1 carries 67% of the per-unit current of the series winding. As the thermal rating is only 33% of the series windings, the transformer is stressed thermally four times as much. Moreover, the tertiary carries current until the fault has been cleared or all power sources have been isolated.

When the tertiary is a zero-sequence source, back-up ground relaying is difficult. The tertiary may be the area's main ground current source, tending to shield remote ground current sources by reducing zero-sequence voltage drop. The effect is greater for low-side faults, where leakage reactance usually is very low.

But tertiary overcurrent protection is inexpensive, simple to apply, and provides both thermal protection and back-up ground relaying. Tertiary thermal rating can be calculated from $K = I^2t$, where t is seconds and I is tertiary amperes. Constant K can be found by substituting the known thermal rating at 2 sec. The overcurrent relay then can be set to trip before tertiary thermal rating is exceeded (Fig. 2).

Montana Power installed 15 tertiary overcurrent relays, which trip station master trip relays to de-energize the autotransformer bank. They have operated an average of less than once a year, never incorrectly. The company feels each operation saved the bank. An autotransformer, even with arresters on the high and low sides, needs tertiary lightning protection in addition to the above relay protection.

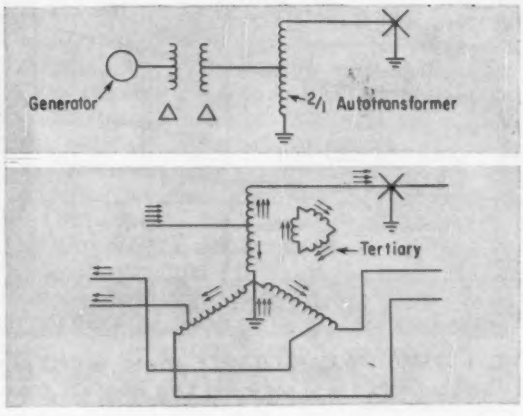


FIG 1—TERTIARY WINDING, rated for ⅓, carries ⅔ of the per unit amps flowing in the series winding which is attributable to a line-to-ground fault.

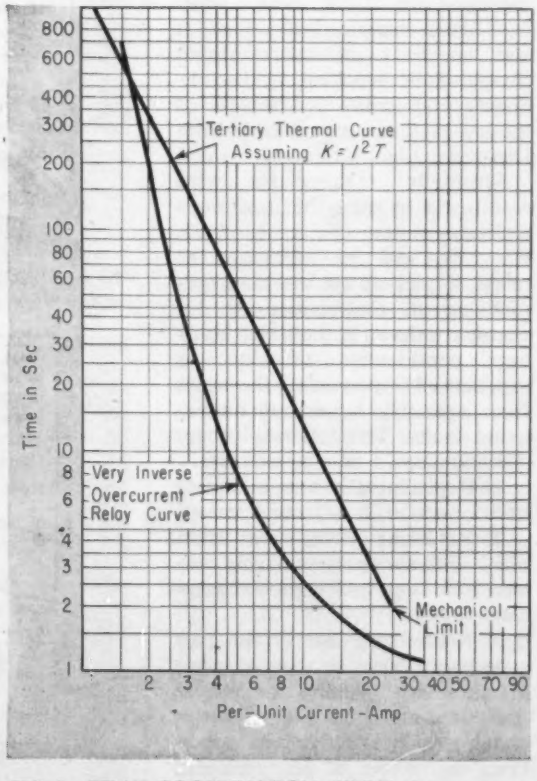


FIG 2—RELAY COORDINATION CURVE shows proper overcurrent protection for tertiary winding and the time settings required for various conditions

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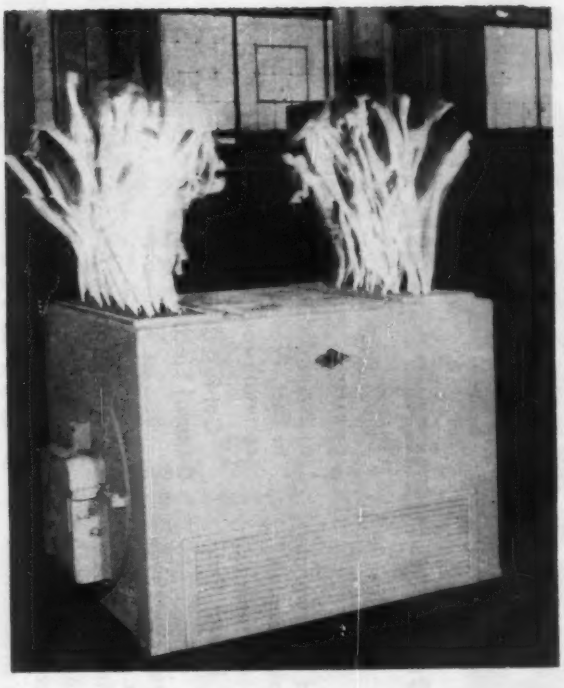


Improved design of boiler feed pump motors for larger generating units enables Northern States Power Co to simplify the problems of pump installation. The jointly-developed design, featuring the discharge of ventilating air vertically from the top of the motor, produces better ventilation and reduces space requirements and maintenance.

Boiler feed pump motors often are grouped together, creating ventilation problems. Horizontal air discharge at the top of the motor concentrates heated air at the operator level. Air intake and discharge openings at the same level increase recirculation and cross-circulation of heated air between motors.

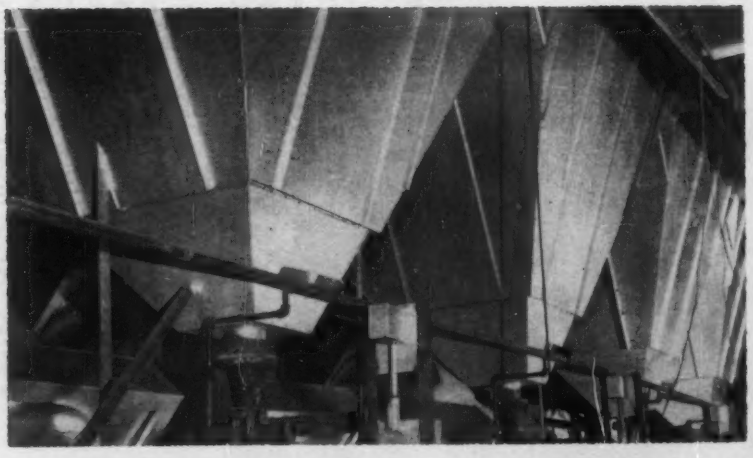
These problems were overcome by introducing air at the bottom of the motor and discharging it vertically from the top. The heated air in rising creates a natural "stack" to lift the air.

Intake air enters through louvers at the bottom of the motor, circulates, and discharges through top louvers. The design provides maximum separation between intake and discharge openings. Interchange of heated air between motors and recirculation are minimized.

Box-type construction, with the air intake at the bottom, eliminates the need for extra height to accomodate an intake at the top. Lower height provides maximum visibility for operators.

To facilitate motor maintenance, the upper half of the bearing brackets can be removed by two men without a hoist.

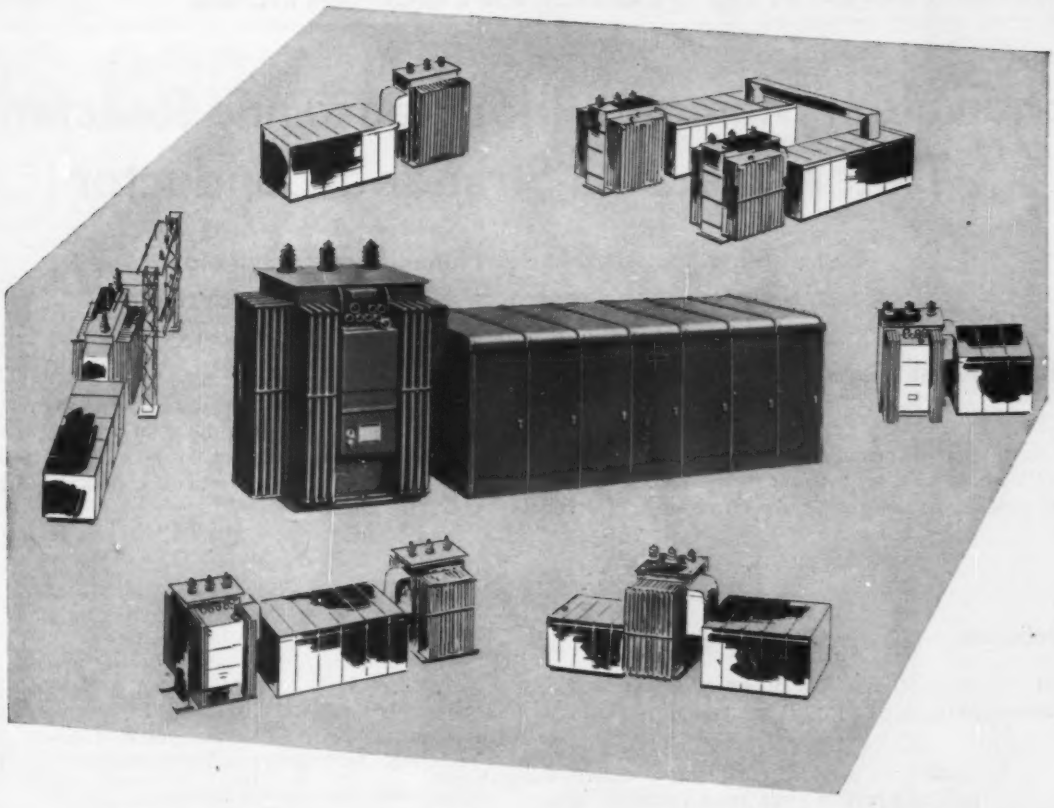
Aluminum Covers Boiler Insulation



ALUMINUM LAGGING covers insulation of boilers and accessories. Joints of convection pass hoppers are standing lock seams secured by a button punch

Aluminum sheet covers insulation on two new outdoor boilers and accessory equipment at Ohio Power Co's Muskingum River plant. While installed cost of the aluminum lagging was estimated at 1.7% above the cost of steel sheet, savings in painting and maintenance costs are expected to justify the added investment cost. In addition, the heat reflecting characteristics of aluminum supplement conventional boiler insulation. The aluminum lagging was cut to shape and formed on the job.

Aluminum sheet also covers insulated breeching, air ducts, fan housings, headers, downcomers, and convection pass hoppers. A total of 140,000 lb of aluminum was used.



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Equivalent Diameter, Inductance and Reactance Determined for Stranded Conductor

Formulas are presented to determine the equivalent diameter, inductance, and reactance of a stranded conductor

FRED C. De WEESE, Consulting Engineer, Raleigh, N. C.

Equivalent diameter of a stranded conductor is a circle whose cross sectional area, less the area between the strands, equals that of a solid conductor of equal cross section. More specifically:

"The equivalent diameter is a circle cutting the outer layer of strands such that the total area between the strands, inside and adjacent to the circle, is equal to twice the total combined area of conducting material outside the circle."

Procedure

1. Equivalent diameter of stranded conductor is determined by Eq (1), Eq (2), and values of C in table.

2. Inductance of stranded conductor is determined by Eq (3). This equation gives exact values of inductance, L, for solid round copper wire. For stranded conductor r_e is substituted for r in the logarithmic term.

3. Reactance of stranded conductor is determined by Eq (4), using $2\Pi f = 376.99$

Example

Given: A 4/0, 7-strand copper conductor, 12-in. spacing (4/0 copper area = 211,600 cm, diam = 0.460 in., at 20C)

Solution: Substituting in the formulas.

$r_e = 0.0005282 \times 460 = 0.24297$ in.

$d_e = 2 \times 0.24297 = 0.48594$ in.

$L = 0.08047 + 0.74113 \times \log (12/0.24297)$
$= 0.08047 + 0.74113 \times 1.69363$
$= 1.33567$ mh per mile

$X = 376.99 \times 1.33567 \times 10^{-3}$
$= 0.50353$ ohms per mile at 60 cycles

Formulas

$$r_e = C \times \sqrt{\text{cm}} \quad (1)$$

$$d_e = 2\,r_e \quad (2)$$

$$L = 0.08047 + 0.74113 \log (D/r) \quad (3)$$

$$X = 2\pi fL \quad (4)$$

where:

d_e = equivalent diameter in inches

r_e = equivalent radius in inches

C = constant for non-magnetic conductor material

cm = circular mil area

L = inductance in millihenries per mile of solid round copper wire, when free of skin effect and proximity effect

D = conductor spacing in inches

r = radius of solid conductor in inches

X = reactance per mile at 60 cycles in ohms

The value of 0.08047 represents the inductance, in millihenries per mile, internal to the conductor. The internal inductance is a constant for non-magnetic solid wire, independent of the wire diameter and conductivity.

Values of C (Constant) for Solid and Stranded Conductors

Strand	C	Strand	C
Solid wire	0.0005000	61-wire	0.0005712
3-wire	0.0005415	91-wire	0.0005730
7-wire	0.0005282	127-wire	0.0005745
12-wire	0.0005859	169-wire	0.0005751
19-wire	0.0005582	217-wire	0.0005756
37-wire	0.0005674	271-wire	0.0005761

Note: Values of C are used only with non-magnetic conductor materials.

as easy as a-b-c

a Locate the best working position, then elevate the all-hydraulic ladder from its stowed position. Three levers control every movement for spotting—rotation, elevation and ladder extension and retraction. Built-in relief valve provides smooth throttling, check valves lock load in position.

b Rotate the ladder under the spot, elevate to the necessary height and extend the ladder, if necessary. Ladder rotates 360°, elevates to 75°, reaches up to 40-foot platform height (4 sizes—for 27-, 31-, 35-, or 40-ft. height).

c Climb the sturdy spruce ladder reinforced with side rail channels. Ladder has fabricated truss end sections, extra-safe ladder hooks that engage two rungs at one time. Tough hickory rungs are inserted in bracket sleeves for easy replacement.

J.H. HOLAN CORPORATION

4100 WEST 150TH STREET
CLEVELAND 35, OHIO

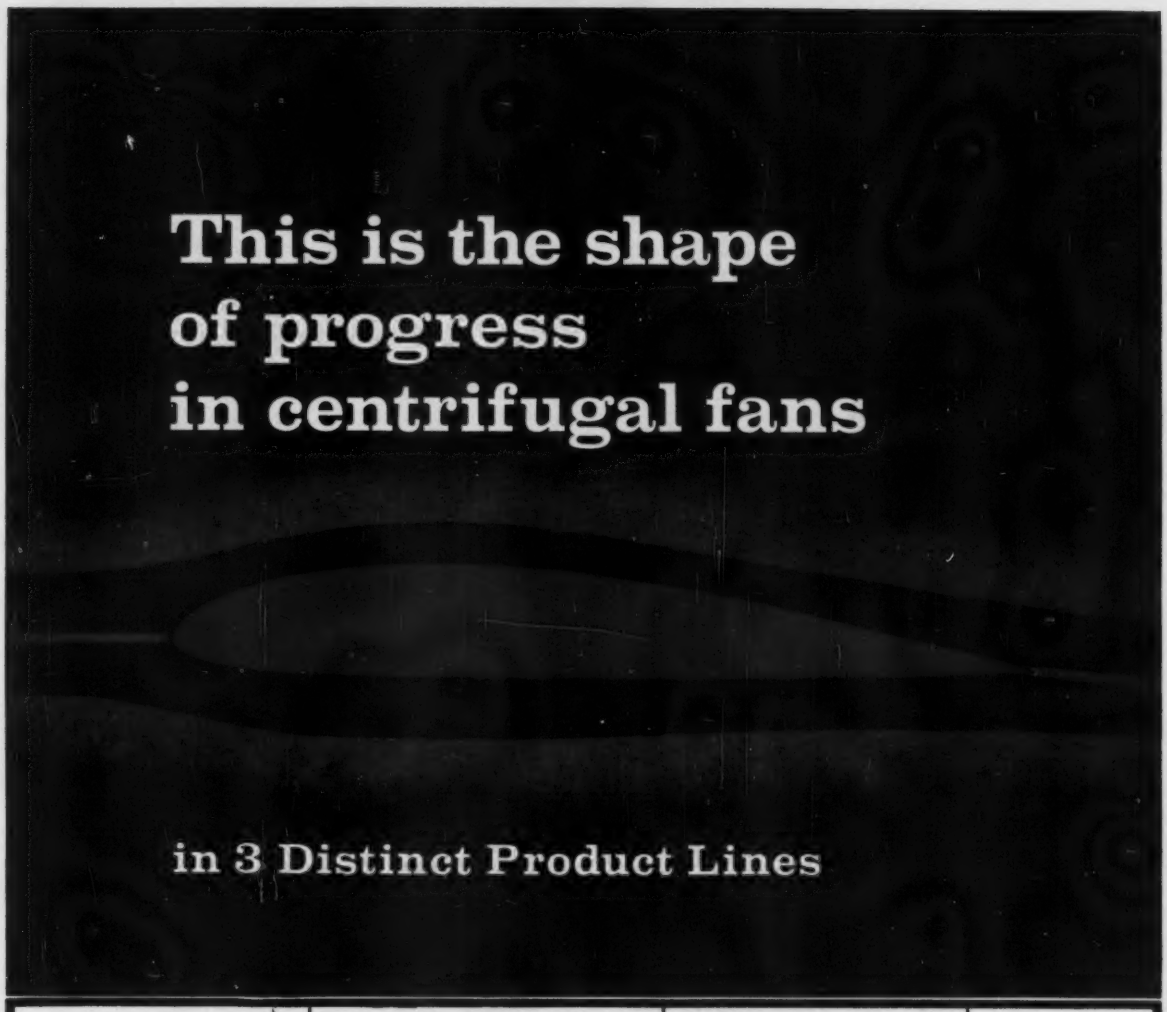
OTHER PLANTS: HOLAN CORPORATION OF GEORGIA, Griffin, Ga.
J. H. HOLAN CORPORATION, PHOENIX DIV., Arizona
BRANTFORD-HOLAN LIMITED, Brantford, Ontario

THE NAME THAT MEANS WORK SIMPLIFICATION

HOLAN SERIES 2100 ALL-HYDRAULIC LADDER IS STILL THE SAFEST, FASTEST AND EASIEST TO USE.

Write for Technical Brochure.

This is the shape of progress in centrifugal fans



in 3 Distinct Product Lines

FULL RANGE APPLICATION	COMBUSTION AIR FOR CONVENTIONAL BOILERS Series 4000	HIGH PRESSURE AIR FOR PRESSURIZED FURNACE BOILERS Series 2200	PRIMARY AIR Series 2100
Volumes (cfm)	10,000 to 700,000	25,000 to 350,000	6,000 to 50,000
Pressures ("H_2O)	Up to 45"	45" to 90"	Up to 65"

Westinghouse Airfoil* blading offers . . .

Lowest Operating Cost
Highest mechanical efficiency ever: over 92%.

Quieter Operation
Perceptibly quieter in actual operation.

Stable Pressure
Ideally suited to single and parallel operation.

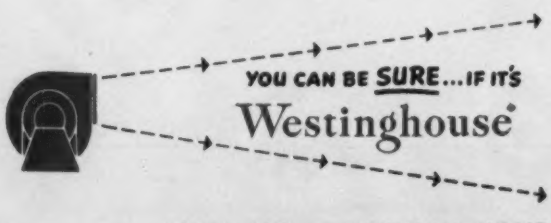
Non-Overloading Power Feature
True self-limiting horsepower characteristic.

Optimum Performance
Sized for specific customer requirements.

Inlet Air Spin Control
Efficient at part loads. Saves power, saves dollars.

Call your nearest Sturtevant Division Sales Engineer, or write Westinghouse Electric Corporation, Dept. G-18, Hyde Park, Boston 36, Massachusetts.

*Trade-Mark J-80669



Westinghouse airfoil fans

serve these leading utilities

COMBUSTION AIR FOR CONVENTIONAL BOILERS

Consolidated Edison
Ohio Valley Electric Corp.
Duke Power Co.
Duquesne Light Co.
Pennsylvania Electric Corp.
Tennessee Valley Authority
Philadelphia Electric Co.
Commonwealth Edison
Dayton Power & Light
Cleveland Electric Illuminating Co.

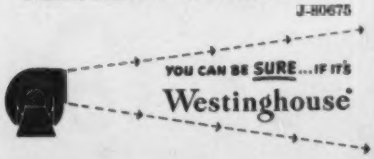
HIGH-PRESSURE AIR FOR PRESSURIZED FURNACE BOILERS

Ohio Power Co.
United Illuminating Co.
Detroit Edison Co.
Appalachian Electric & Power Co.
Indiana & Michigan Electric Co.
Atlantic City Electric Co.
Missouri Public Service
Memphis Light & Power Co.

PRIMARY AIR

Detroit Edison
Consolidated Edison
Toledo Edison
Ohio Power Co.
New England Power
Virginia Electric & Power
Delaware Power & Light
Public Service Electric & Gas

J-80675



Discrimination Charge Hit By Pacific Power & Light

Charges that the Springfield, Ore., municipal electric system has "repeatedly and unlawfully" violated its established rates and regulations in efforts to attract customers from the competing service of Pacific Power & Light Co have been filed with the Oregon Public Utilities Commissioner.

PP&L's charges were contained in an answer to a complaint of Public Utilities Commissioner Howard Morgan alleging that PP&L had made "unjust discrimination in charges for service" and given undue preference among water and electric customers in competing with the municipal system.

The private power company said it has been compelled during the past eight years to meet rates of the city system and has done so legally under provisions of a PUC order of 1950. Any denial of the right to operate competitively would have "deprived the company of its property without due process of law," the answer stated.

Pacific Power asserted the municipal system has shown preference to certain customers in violation of the city's formally established rates, applied improper rates to certain customers, charged certain commercial and industrial customers less than required and failed to collect demand charges as provided by schedules and regulations adopted by the city council and the utilities board.

The city has also disconnected existing facilities of the competitive PP&L system and connected its own electrical facilities without lawful authority to do so, the company charged.

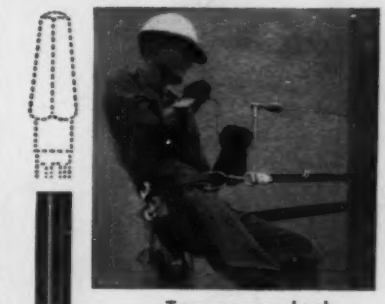
The company said it will ask subpoenas of city records for use in any hearing growing out of the competitive situation in Springfield.

SMUD Orders Two Generators

Sacramento Municipal Utility District has awarded a $2,442,482 contract to GE for two 68,000-kva generators for its Jaybird Powerhouse.

New adapter shank bit

fits either hand brace or power drill



Taper square shank fits hand braces

Cut off taper and use "hex" shank in both power drills and hand braces

Cut your wood bit inventory by 50%

Now you can eliminate the need to stock two types of wood auger bits. Irwin's new Adapter Shank Bit fits both hand braces and power drills.

With hand braces, use the Adapter Shank Bit as it comes. Cut off taper square and the Adapter Shank, with its 6 "hex flats", chucks perfectly in power drills or hand braces, either one. No wobble, no run-out. Clean, efficient cutting action. Reduces inventory and record keeping by 50%. Saves time on the job, too. Call your distributor, or write today for complete information. Sizes 4/16" to 17/16", both solid center and single twist types.

***All Irwin Adapter Shank Wood Bits** are forged in one piece from special steel and heat tempered full length for longer life. Plastic coating on balanced cutting heads guarantees factory-fresh sharpness, unequalled performance. Widely used by utilities, electricians and construction workers.*

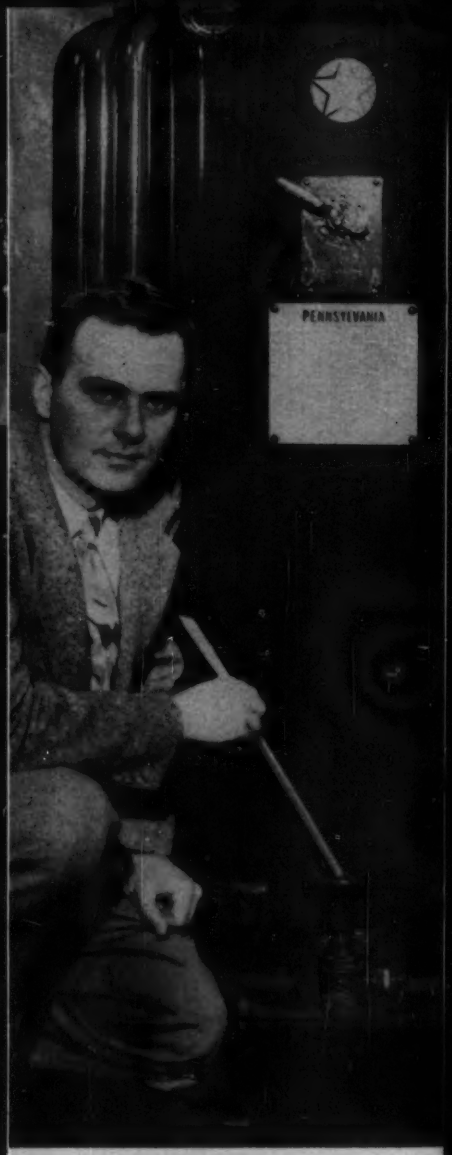
IRWIN auger bits • screw drivers
Wilmington, Ohio

4-step finish gives lasting protection

Thousands of installations have proved the long-lasting quality of the Pole Star four-step finish. It begins with shot-blasting of all external surfaces, to remove scale, grease and dirt, and to provide "toothage" for adhesion of the first coat of paint. Then, three coats of paint are applied. The first two are flowed on to assure complete coverage. The third, finish coat, is sprayed.

Freon gas test okays all seams

Gasketed and welded joints are checked with the highly reliable freon gas leak detection test. The transformer is placed under positive gas pressure with a charge of freon gas. If *any* gas leaks through the joints of tank, cover, or bushings, it is drawn into the electronic "sniffer gun" to an electronic detector circuit that actuates an alarm. If a leak is detected, the faulty seal is corrected and retested.



"Low-Set" valve drains entire tank

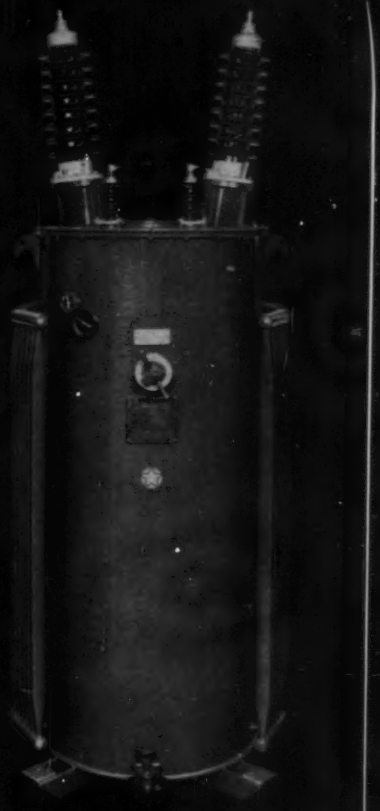
Intermediate-size Pole Star transformers are now equipped with the Pennsylvania "low-set" power transformer drain valve. Now, it is no longer necessary to tip the transformer or apply internal pressure to completely drain the tank. As a result, there will be no mixture of old and new oil—a precaution that can pay off in additional years of trouble-free service.

Controlled tube production pays off in quality

To maintain consistently high quality, the entire production of cooling tubes and radiators is handled in Pennsylvania's own plant. Facilities include a modern electric-weld tube mill. Details such as the welding coolant, seam quality, and storage procedure are under constant surveillance. Rigid control in the production of this important transformer component makes a difference as the years of service begin to add up.

Rugged base makes maintenance easier

Welded solidly to the tank, the base of intermediate Pole Stars has four large openings for ventilation, to prevent condensation on the tank bottom. These openings also facilitate cleaning and painting in the field. To facilitate jacking, base jacklugs extend either between or beyond tubes and radiators. The transformer can be rolled in any direction.



externally, too . . . you get power transformer ruggedness with intermediate

PENNSYLVANIA® POLE STAR® DISTRIBUTION TRANSFORMERS

250 through 500 kva

a product of

Pennsylvania Transformer Division

McGRAW-EDISON COMPANY

Canonsburg, Pennsylvania

McGRAW-EDISON

POLE STAR

Idea Exchange Can Aid Utilities' Management

New West Penn Power Co president, Streuby L. Drumm, believes there would be a big potential in top executive sessions

A field of opportunity is open to investor-owned business-managed utilities aiming for improved management methods. According to Streuby L. Drumm, newly elected president of West Penn Power Co, the field of promise is in increased exchange of ideas and information on management techniques and method improvements among power company executives.

Companies can realize benefits if more top officers "spend a little time discussing these matters" of motivating, organizing, planning, prodding, and controlling their organizations, said the soft-spoken New Orleans native.

"After all, we have the same objectives," Drumm said. The regulatory climate in which the industry operates and area restrictions to which it must conform rules out competition between power companies, he said. This can pave the way to either sectional or national get-togethers possessing "broad implications and applications to both small and large companies," he opined.

Evolutionary Process

His views on management exchange of ideas are not critical of the industry, he explained. Rather, they are "another step in the evolutionary process of a young industry," which, having made good progress in management methods, recognizes the job is not yet done.

Elected on July 2 to the post vacated by retiring Philip H. Powers, Drumm started in the industry in 1923 with the construction division of Electric Bond & Share as an assistant electrical engineer. Two years later he joined the New Orleans Public Service, Inc, sales organization and advanced to a vice presidential post in 1949. In 1954 he was elected executive vice president and a director of West Penn Power Co.

Powers, a veteran of 44 years in the industry and head of West Penn Power for the past ten years, has been active in Edison Electric Institute activities. He is a member of the trade group's board of directors and is past president of the Pennsylvania Electric Association.

Drumm views the chief officer's role as one which suffers if hamstrung by "putting out day-to-day fires." With a good organization capable of handling the many internal problems of utility operation, the chief officer can concentrate on the broader challenges, including planning ahead for the company's growth and meeting the socialistic threat of the public power zealots, he said.

As he pointed out in a talk at the Edison Electric Institute convention in Boston last month, one of the industry's biggest challenges is the need for raising "sums of money that dwarf what we are raising now" for expansion. The history shows that three-fourths of the electric companies' present plant investment was made in the past 20 years. Based on forecasts of the companies' growth, about three-fourths of the $221 billion which, it is estimated, will be invested in 1978 will have come in the 20 years ahead, he told the EEI meeting.

NEW LINE-UP at West Penn Power finds S. L. Drumm, left, in president's post vacated by Philip Powers who retired

"Top management should constantly motivate, organize plan, control and prod," Drumm told the EEI delegates. When asked for examples on controlling and prodding, he put it this way:

"The control aspect is inherent in the recognized need for delegation of responsibility and authority. Coincidental to this is the accountability of those executives to whom this responsibility and authority is given. Our control rests, then, on the objective results of the executives, and these results are the basis for the prodding. The qualitative as well as quantitative results will tell us if we're achieving our goals."

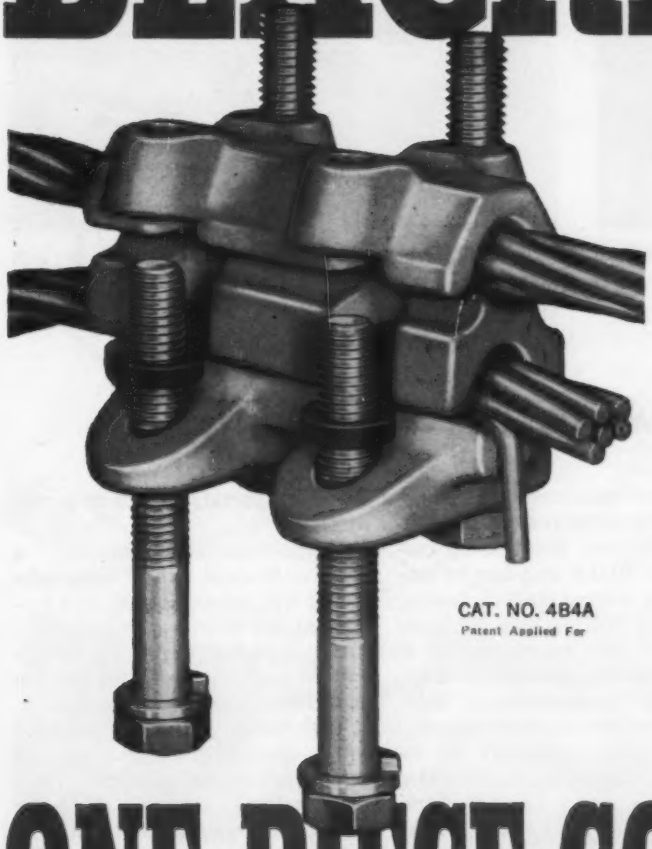
A sales-oriented officer who belies the back-slapping high-pressure salesman stereotype, Drumm feels strongly about the success of the all-electric sales promotion program that EEI is launching in 1959. "We can't afford not to have it a success," he said. West Penn Power Co is already committed on participation in the promotional effort.

He's confident that with the foresight and ability of the industry's salesmen, "we'll meet the challenge" of estimates for electric utilization in 1979, the industry's 100th anniversary. "It will require the best type of leadership in marketing," however, to hit sales goals of 3 trillion kwhr within 21 years, he said.

Described as a man able to put visitors at ease within minutes, Drumm allocates most of his spare time to his family, which includes four granddaughters and one grandson. He is a graduate of the U. S. Naval Academy and served in the Navy in both World Wars.

It's New! Installs quicker...easier

BLACKBURN



CAT. NO. 4B4A
Patent Applied For

It's here... a heavy duty one-piece 4-bolt connector with all the electrical and mechanical advantages of a U-bolt connector... yet much easier to install.

No bothersome nuts, washers, housings, spacer to take apart and assemble. Just three quick, easy steps and installation is completed.

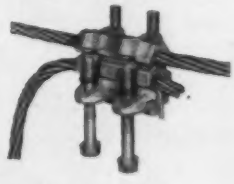
Housings are of non-copper-bearing aluminum alloy. Spacer of soft aluminum pig protects conductor, aids conductivity. Spacer treated with heavy coating of oxide inhibiting compound. Hardware is high strength aluminum alloy completely alumilited to prevent seizing.

WIDE RANGE...
Accommodates conductors—2/0 to 397.5 ACSR—3/0 to 477 MCM.

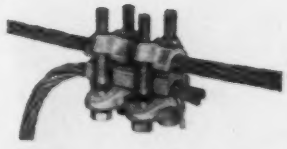
ONE-PIECE CONNECTOR

HERE'S HOW EASY THE NEW 4-BOLT CONNECTOR IS TO INSTALL

Unscrew the two free bolts contained with neoprene washers and hang over main.



Insert tap wire.



Tighten and you have the ultimate in a good connection.

Available through electrical wholesalers everywhere

JASPER BLACKBURN CORPORATION

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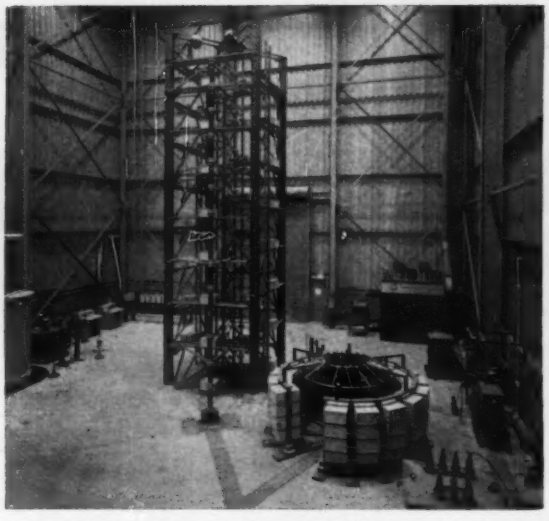
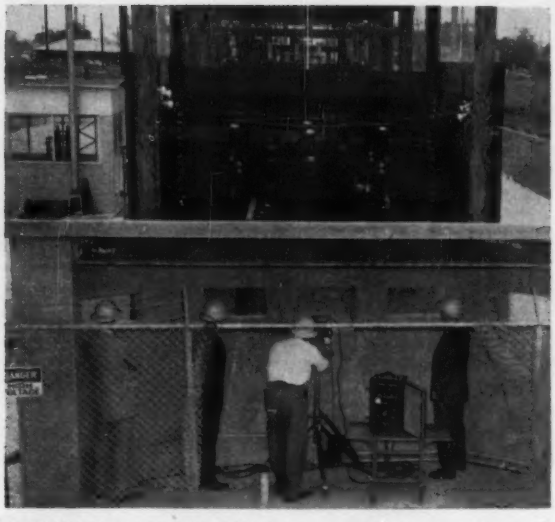


INDOOR LABORATORY has 3,200,000-v surge generator, center, three impulse generators, and an 80 kw-sec, 100-kv impulse current generator, circular form



OUTDOOR LABORATORY has concrete barricade with bullet-proof glass peep holes to observe tests in the background area at close range.

Hubbard Opens New Research Facilities

Recognition of the growing need for research facilities for development of electrical equipment has prompted Hubbard and Co to establish an extensive laboratory facility in McCook, Ill., a Chicago suburb. The site is in an industrial area where test noises and line disturbances are not objectionable.

Formal opening of the laboratory will be observed with open-house ceremonies on July 22.

Designed for developing and testing high-capacity, high-voltage equipment, the laboratory has a 138-kv power supply from the Commonwealth Edison Co system through a transformer designed especially to meet laboratory and testing requirements. Short-circuit currents up to 30,000 amp can be produced. For normal 60-cycle testing, distribution voltages are available in 1.5 and 3-kv increments up to 25-kv. Complete control can be exercised over the initiation of faults. power factor and recovery voltage.

Five impulse generators are installed: A 3,200,000-v, a 500,000-v, a 250,000-v, and a 125,000-v generator, also an 80-kw-sec, 100-kv impulse current generator.

These generators can be applied singly or collectively to simulate multiple lightning strokes to power systems.

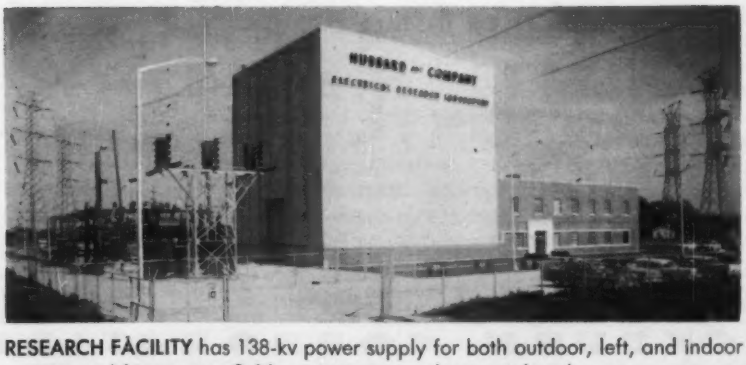
Other equipment includes a 600-kv, 60-cycle test set with automated wet test equipment and several smaller 60-cycle test sets.

The high-bay section of the lab will permit operation of the impulse generators at maximum voltage.

High-power testing is conducted in a specially designed outdoor power laboratory adjacent to the main building. A concrete barricade with bullet-proof glass permits visual observation at close range. Unusual, ultra-high-speed photographic equipment records various phenomena associated with the high-voltage and high-current tests. Most complete high-speed measuring facilities have been provided. Cathode ray oscilloscopes, multi-channel magnetic oscillographs, and mechanical recorders are available for completely recording test results. Study of these and the photographic record permit thorough analysis of the test results.

Short lines are being built on the six-acre tract adjacent to the laboratory. Here, it is anticipated, many of the conditions of field operation will be reproduced.

Chemical and mechanical laboratory facilities are also available.



RESEARCH FACILITY has 138-kv power supply for both outdoor, left, and indoor testing, and here many field operations may be reproduced.

NOW!

LIGHTER THAN A WALKIE-TALKIE!

CONVENIENT AS A "WRIST" RADIO!

a NEW transistorized miniature 2-way "Belt" Radio

RCA Personalfone

The 2-Way Radio You Wear!

Today's biggest news in the communications field! The same communications mobility for roving personnel as RCA 2-Way Carfone Radio gives to trucks! Small transistorized receiver and a companion transmitter in two handy leather pouches that are worn on the user's belt. Personalfone can be combined with RCA mobile radio to provide faster and more flexible communications. Used by guards, watchmen, maintenance men, mechanics, firemen, police and a wide range of applications.

RCA Personalfone Transistorized FM Radio

- **Adjustable to any frequency in the 150 mc band.**
- **Receiver and transmitter in separate leather pouches.**
- **"Battery Saver" provides long battery life—150 hours minimum.**
- **Sealed-selectivity-fixed IF filter and crystal control assure excellent selectivity and stability.**
- **Equipped with antenna, battery, microphone, speaker or earphone.**

RCA...world leader in radio... offers you quality communications equipment to meet every requirement. Advanced engineering means greatest satisfaction, lowest maintenance. Expert service by RCA's own communications technicians. Find out about this efficient time-saving equipment today. Use coupon.

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☐ Please send me FREE booklet on RCA Personalfone Equipment recommended for

NAME _____ TITLE _____
PLEASE PRINT

COMPANY _____

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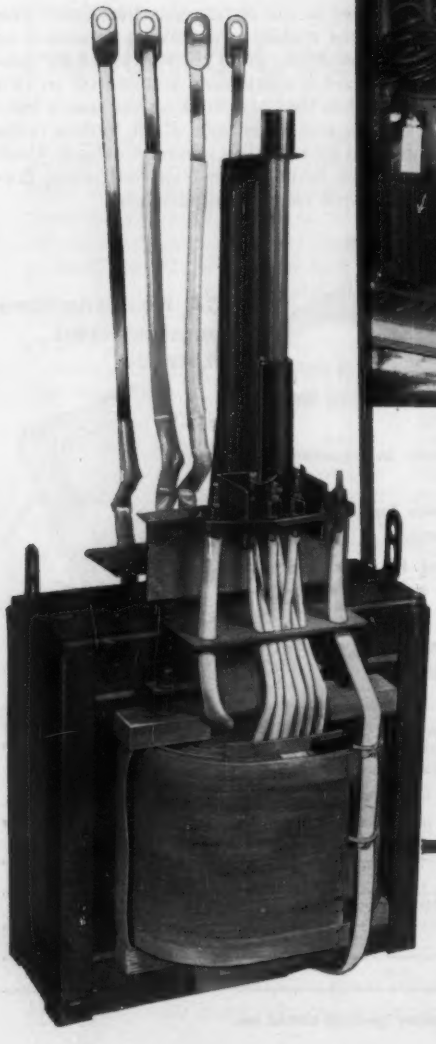
☐ Have RCA Communications Specialist contact me.

WAGNER FORM W TRANSFORMERS

Here is a portion of Wagner's distribution transformer plant. Wagner has been building transformers since 1893, and today's Form W Transformers bring you the benefits of the experience gained during those 65 years.



Wagner Form W Construction makes the difference

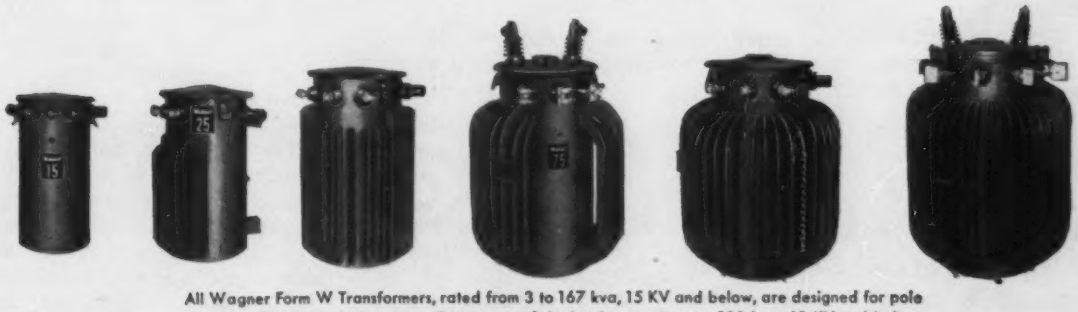
The Form W design, with oriented grain transformer steel cores, specially annealed for lowest possible magnetic losses, permits smaller and lighter elements that give excellent electrical performance with high overload capacity for peak loads. Get the full story—ask for Bulletin TU-141.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

Small in size...
light in weight...*BUT*
LIBERALLY DESIGNED
TO GIVE YOU MANY
YEARS OF TROUBLEFREE
SERVICE!

Form W Cores are cut into two turn sections and are assembled through and around the pure copper wire coils.

Form W Transformers are given all prescribed commercial tests and production line impulse tests to meet Wagner's standards for uniformly high quality.



All Wagner Form W Transformers, rated from 3 to 167 kva, 15 KV and below, are designed for pole mounting. The line includes a complete range of single-phase ratings to 500 kva, 69 KV and below.

WT58-13

Wagner Electric Corporation

6456 PLYMOUTH AVENUE, ST. LOUIS 14, MISSOURI

Manufacturers News

FPE Enters Protective Relay Field

Production of protective relays is a new field for Federal Pacific Electric Co, Newark, N. J. They are now being produced on a pilot line basis, according to T. M. Cole, executive vice president. Shown above examining some relays in early production are, left to right, Paul M. Christensen, coordinator of engineering, Ernest W. Stohr, engineering manager-relays, and Richard S. Smithley, relay application engineer.

The various protective relays use only three basic movements, two most important being the induction disk and the induction cup. Induction disk is used with relays requiring adjustable time characteristics. Induction cup is used for instantaneous relaying applications where operating times of a cycle or less are required, together with an accuracy of $\pm 2\%$. The third basic movement is a combined electrical operation indicator and seal-in contactor of a hinged armature design available for auxiliary relays.

Models of Type CDG 11, a time delay overcurrent relay, and Type VAT 11, a timing relay, are the initial units which have been shown to utility engineers and representatives.

Allis-Chalmers Reports on Equipment and Orders

Significant equipment developments by Allis-Chalmers Mfg Co, Milwaukee, Wis., include a new high in potential transformers, two hydraulic turbines for a $2 million contract, and a transformer for a 220-kv grid system.

• An instrument potential transformer of the reportedly highest voltage class has been built for the Southern California Edison Co. A 230-kv unit, it utilizes insulation techniques developed by A-C engineers such as coordination insulation and additional refinements in the use of materials.

The transformer has corona free construction and is hermetically sealed. Tank design conforms to the shape of the core and coil element for a compact unit. This potential transformer weighs about 60% less than conventionally constructed potential transformers in this rating.

• A contract for nearly $2 million for two large capacity hydraulic turbines for the Sacramento Municipal Utility District's upper American River Project, Jaybird Powerhouse, near Placerville, Calif, has been awarded to Allis-Chalmers.

Each of the 88,000-hp. 1432-ft head multi-jet impulse type turbines will have cabinet type oil pressure governors and high pressure rotary type shut-off valves. The rotary valves will be nearly 5 ft in diam and among the largest of this type ever built by the company.

• The first in a series of large power transformers for a 220-kv grid, to be constructed around the District of Columbia, have been delivered to the Takoma Park, Md., substation of the Potomac Electric Power Co. The 100,000-kva, 220-36-kv, 402,000-lb unit is approximately 25 ft long, 17 ft wide, and 24 ft high. It is equipped with a load tap changer and cools itself with four Electro-Cooler units that dissipate the heat produced when carrying load.

New Zealand Is Test Site for 250-Kv DC Cable

A 250-kv d-c trial cable has been built at the Trafford Park Works of British Insulated Callender's Cables Ltd, London and was shipped to New Zealand. Laid May 31, it will provide data for the ultimate installation of a submarine power cable across Cook Strait. It was laid seaward from Oteranga Bay.

The trial cable, half a mile in length and with an over-all diameter of 5-in., is a single-core, pre-impregnated high-pressure gas-filled type. The cable was coiled on a giant drum 15 ft 8 in. in diameter, 7 ft 6 in. wide and weighed 45 tons.

Sangamo BH Transformer

Sangamo Electric Co, Springfield, Ill., has an indoor-outdoor 600-v current transformer. This Type BH

(*Continued on page* 80)

To meet your load demands before they arise

INDUSTRY'S MOST COMPLETE POWER TRANSFORMER TEST CENTER . . . ANOTHER EXAMPLE OF EARNINGS PLOWED BACK

Since its inauguration in November, 1956, the power transformer test center has extended the ability of Westinghouse to provide equipment with the capacity to meet the needs of the electric utility industry before they arise.

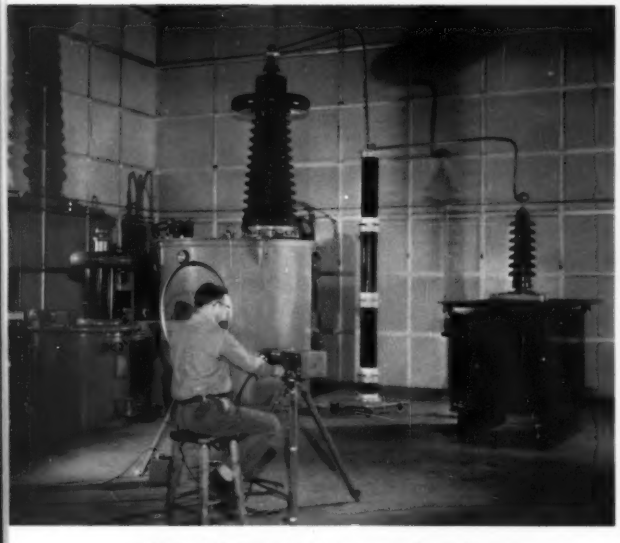
Such technical advances as more capacity in single units, reduction of vibration and noise, new insulation systems, and materials with greater endurance limits emerge from these facilities—not as ideas or experiments, but as scientifically designed, tested and proved realities.

In noise testing, for example, an anechoic chamber, roughly the size of a five-story building, cuts out extraneous sound so that exact levels of transformer "hum" may be measured and studied. This giant vault, designed to accommodate transformer ratings foreseen for the next decade, provides data which promise development of transformers that will be smaller, quieter, lighter and more capable.

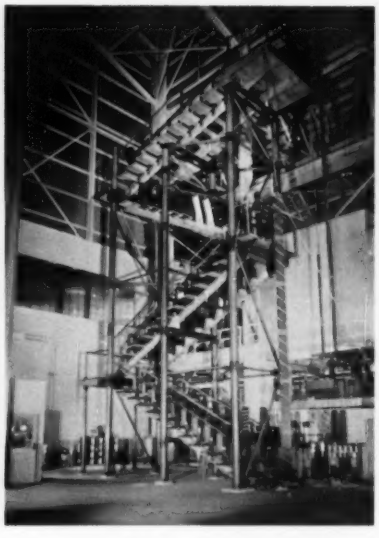
YOU CAN BE SURE...IF IT'S

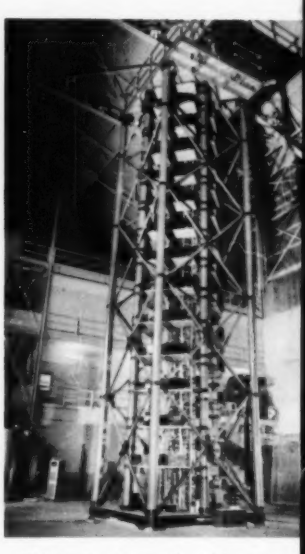
Westinghouse

Equipment at the test center designs and proves Westinghouse power transformer superiorities



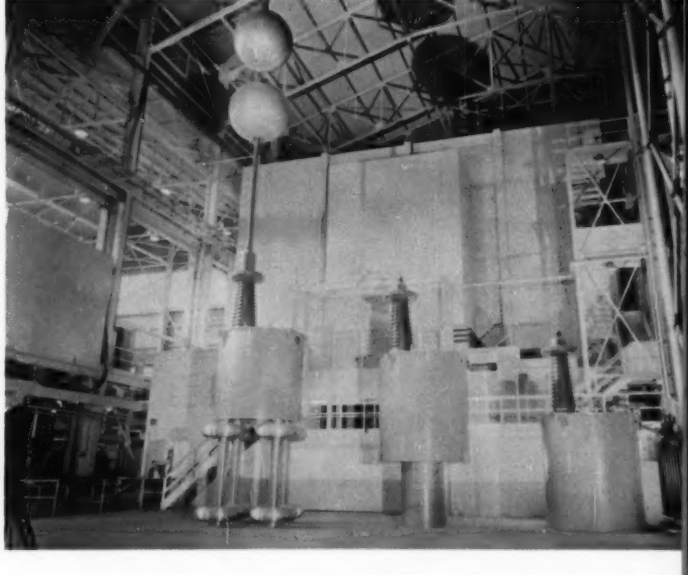
Radio influence tests on power transformers are made to determine means to minimize interference with all types of electronically controlled equipment, from television receivers to aircraft fire control. These tests are also employed to study effects of ionization on insulation.





Impulse generators to test the dielectric strength of insulation range in capacity from 400,000 volts to 5,200,000 volts. In the present trend toward larger transformers with higher voltage and kva ratings, these tests provide vital information for the development of reduced insulation levels—resulting in smaller, lighter transformers, with greater capacity.

A three-unit cascade system, producing 1,050,000 volts, is used in low-frequency testing of insulation. Above the high-voltage unit of the system are two 200-centimeter spheres, positioned there to obtain the clearances required by sphere gap standards, for normal dielectric and impulse tests.



For full information on developments which are daily increasing our capacity to make your transformer investment a better one, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

JI-97228-2

YOU CAN BE SURE... IF IT'S Westinghouse

Westinghouse Type "O"... only service-proved ASA bushing

Includes ratings 92 through 196kv

Westinghouse Type "O" bushings have an unmatched service record—demonstrated by over 300,000 bushing years of trouble-free service. Because new ASA dimensional requirements were achieved with no basic change in design, this is the only ASA bushing that is service-proved. Type "O" bushings offer plus values derived from over 50 years of Westinghouse leadership in condenser bushing design. Continuous research and development—made possible through PLOWBACK OF EARNINGS by Westinghouse—have produced these extra bushing features:

Exclusive, fully insulated potential device tap, unchanged dimensionally for 25 years, provides standard cable connection for any Westinghouse potential device. Does not have to be grounded —thus valuable bushing insulation is fully used at all times.

Extra interchangeability is achieved, in addition to the interchangeability with other manufacturers' bushings provided by ASA dimensions. Westinghouse ASA transformer bushings are designed to permit direct replacement of many older bushings. Westinghouse ASA circuit breaker bushings can be made interchangeable with flange and stud adapters.

Inventory savings are now possible: With Westinghouse ASA bushings as spares, bushing stocks can be reduced to a minimum. No adapters are required for most Westinghouse transformers.

Ask your Westinghouse representative about the ASA Type "O" bushings . . . or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-70880

YOU CAN BE SURE...IF IT'S **Westinghouse**

The superiority of the Westinghouse one-piece weather casing of wet-process porcelain is pointed out by Bob Rung, Transformer Components Sales Manager. Loaded in compression only, it provides the Type "O" bushing with exceptional mechanical strength.

Repeated testing of Type "O" bushings as part of high-voltage power circuit breaker development program proves the superior mechanical and electrical strength of these bushings has been maintained in achieving interchangeability, as provided by new ASA standards.

Ask your

Westinghouse representative

about the exclusive benefits

you get from

URL AND URF

REGULATORS...

WITH 1¼%-STEP

REGULATION

Westinghouse URL and URF voltage regulators, with 1¼% steps, provide improved regulation . . . with a minimum of corrective operations. Here's why:

The "set" bandwidth describes the limits outside of which voltage correction is called for. Since correction stops when voltage is brought back within the band, smaller steps require narrower band settings for the same quality of regulation . . . but narrower band settings require extra tap-changer operations.

Thus, the 1¼%-step regulation of Westinghouse URL and URF regulators provides an effective voltage that is closer to the balance voltage—the narrowest *effective* bandwidth, with the *fewest* operations.

Call your Westinghouse representative for the complete story about this special quality of regulation—the result of PLOWBACK OF EARNINGS into research to provide better methods for voltage control in your electrical distribution system.

J-70861

YOU CAN BE SURE...IF IT'S Westinghouse

Sangamo Transformer

(*Continued From Page 76*)

is reportedly smaller and lighter than previous models and is encapsulated in an epoxy resin. It is available in window-type and flat-bar construction, in ratings up to 800 amp and a double range 200/400 amp.

GE to Add $1 Million Lab To Simulate Overvoltage

Construction is starting immediately on a new $1,000,000 high voltage laboratory for the testing of switchgear products rated 750 kv and higher, to be built in Philadelphia by General Electric Co.

In making the announcement, V. L. Cox, manager of the Laboratories Department of the company's Switchgear and Control Division, said the laboratory will contain testing equipment that will simulate overvoltage conditions produced by lightning and other dynamic overvoltages that occur on transmission and distribution lines.

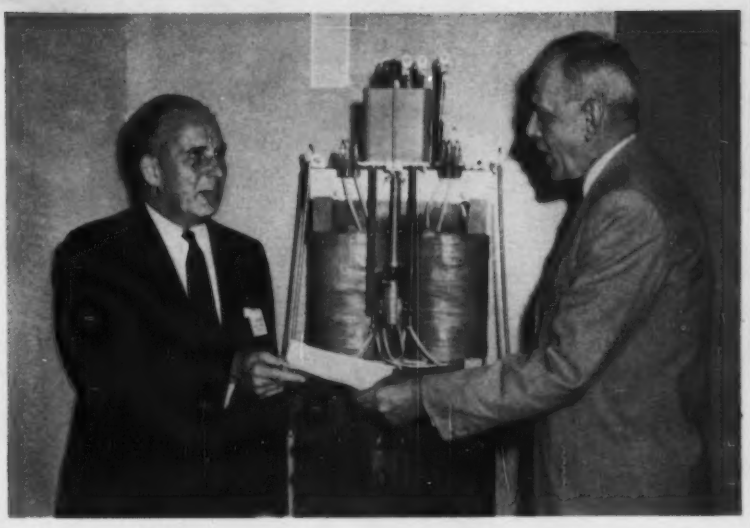
To be completed by July 1959 the new research and development facility will be an addition to the company's $10 million switchgear laboratory completed in 1952 for short circuit testing of circuit breakers and other power devices. The new laboratory will complement the work to be done by the extra high voltage project announced earlier this month.

• Also reported by General Electric Co was the establishment at Atlanta, Ga., of a major center for repair of electrical instruments. The center will serve the Southeast from the Carolinas to Louisiana.

• One of the largest high-voltage series capacitor installations has been energized by Louisiana Power & Light Co. The rating is 57,600 kvar, 115/161 kv, 60 cycles, 600 amp, 3-phase. Supplier was G.E.

Installed at Bogalusa Station, 50 miles north of New Orleans, the circuit load from southern Louisiana to the north was increased from about 60,000 kw to 90,000 kw.

The series capacitors reduce inductive reactance for the new larger conductor on a transmission line, and also decrease system losses and voltage drop.



First SRT Is Ordered by Detroit Edison

First order for the first self regulating transformer was accepted by R. G. Wheaton, right, president, Line Material Industries, from E. R. Moore, manager of engineering, Detroit Edison Co. The order was placed during Line Material's press conference on June 19 in Chicago when the first announcement of the self regulating transformer was made.

Based on the teaser advertisements run in Electrical World, which carried the mysterious SRT announcements, some Detroit Edison engineers speculated as to what SRT meant, even as did Electrical World, p 19, June 16 issue. As a result of their speculation Moore brought the order to the announcement party.

"Buy Canadian" Campaign Used by Electrical Industry

Toronto—(McGraw-Hill World News)—With nearly half Canada's electrical manufacturing capacity standing idle, the "Buy Canadian" campaign is getting wholehearted support from the electrical industry.

Manufacturers are incorporating the slogan into most of their advertising and direct mail. Some have put the slogan on their letterhead. Says one slogan in common use, "Buy Canadian is more than a slogan—your job depends on it."

The recession and plant shutdowns have highlighted the old problem of cheap imports which are still pouring into Canada at an apparently undiminished rate.

As a result of this, some of the promotion being used within the electrical industry is reflecting the bitterness of some manufacturers. Slogans which imply that Canadians *must* buy Canadian to save themselves from unemployment or financial trouble are causing anxiety amongst responsible manufacturers and utility chiefs who feel that the campaign could easily be used as a weapon against all imports and overseas manufacturers.

However, many Canadian Electrical Manufacturing Association members believe that some revision of import regulations is long overdue, particularly with regard to the import of English, German, Japanese and some poor quality American equipment.

S. M. Smith Has Order for 1009-Ft. Head Turbines

S. Morgan Smith Co, York, Pa., has received a contract for two Francis-type hydraulic turbine units with inlet valves and pressure regulators for the Mammoth Pool hydro-

(*Continued on page* 84)

Westinghouse

1¼%-step

regulation . . .

REQUIRES FEWER OPERATIONS. INCREASES CONTACT LIFE

Westinghouse URL and URF regulators with 1¼% steps require 42% fewer operations to maintain the narrowest *effective* bandwidth. This means that:

- **Contact life is increased.**
- **Oil carbonization is reduced.**
- **Maintenance costs drop.**

For better regulation, insist on the total package: 1¼% step, inverse-time relay, instant-response tap changer.

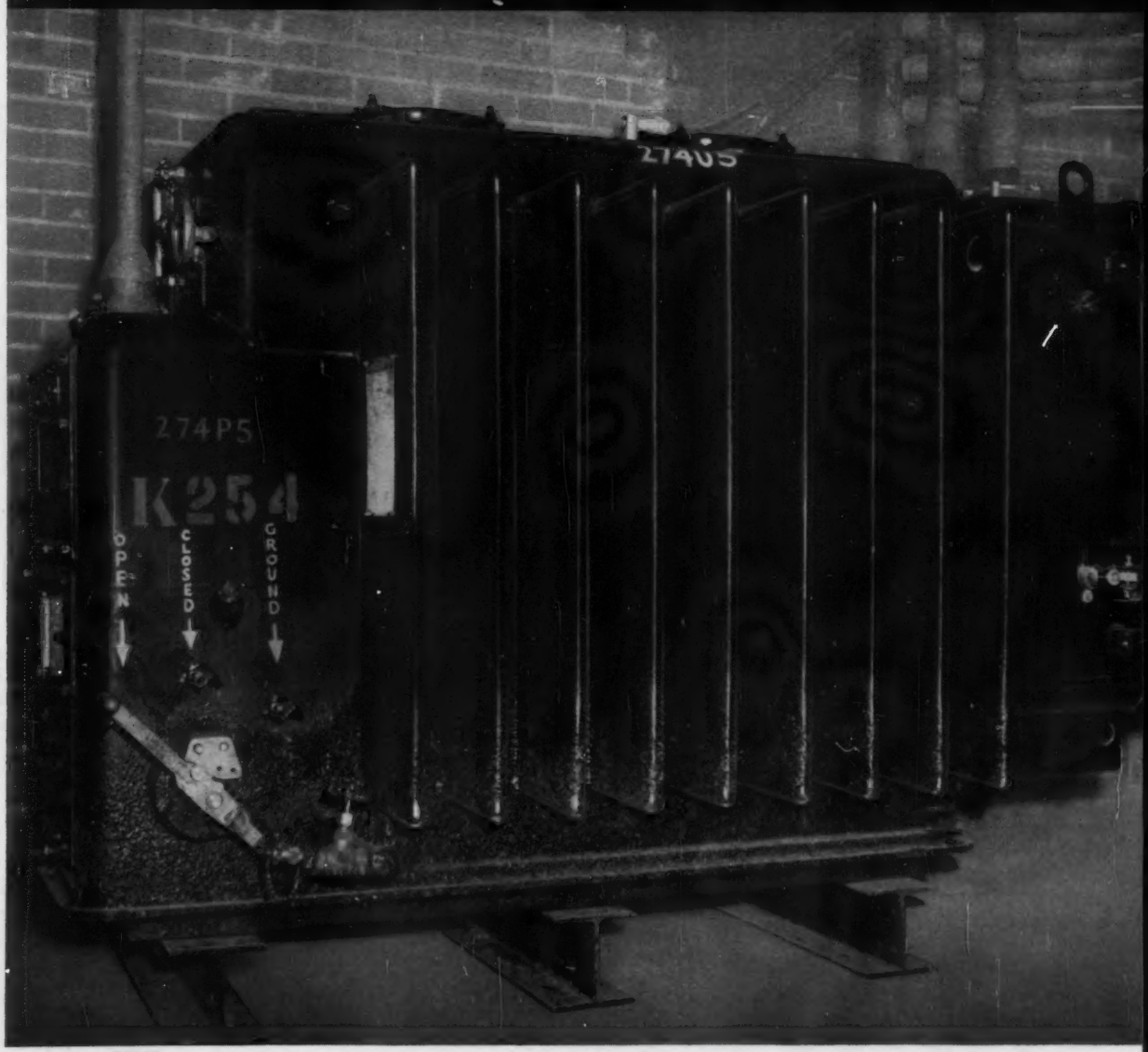
J-70862

YOU CAN BE SURE...IF IT'S

Westinghouse

Cut network costs three ways . . .

SPACE-MISER NETWORK ON ORIGINAL COST, MAINTENANCE



TRANSFORMERS SAVE INSTALLATION AND

Along with other leading utilities, New York State Electric & Gas Corporation has been quick to recognize the cost-cutting advantages of the SPACE-MISER transformer in their network operations. The SPACE-MISER offers a big three-way saving—whether for original or replacement installation . . . here's how:

Standard design saves on original cost. The SPACE-MISER meets all EEI-NEMA Standards and most customer requirements without modifications. There are no expensive "extras" normally required.

20% size and weight reduction cuts installation cost. New vaults can be built smaller. Existing transformers can be replaced with higher rating SPACE-MISERS, without vault alterations. Installation is faster, easier—handling safer.

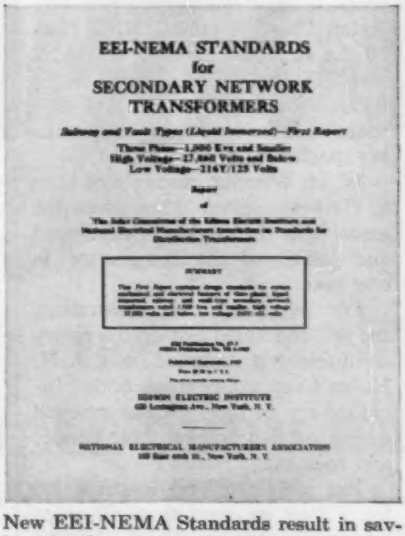
New tank and coolers cut maintenance. The contoured tank and Yukon coolers provide smooth surfaces that readily shed corrosive materials. Streamlined design eliminates sharp edges where corrosion starts. Greater clearances between coolers provide easy accessibility for inspection, cleaning or repainting.

The all-important overload ability and long life required for network use have been fully retained, while providing these new advantages found only in SPACE-MISER.

Call your Westinghouse representative for the complete story of the SPACE-MISER . . . another development made possible through Plowback of Earnings into research. Or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-70871

Inside a network vault of New York State Electric & Gas Corp., Binghamton, N.Y.: another SPACE-MISER transformer installed by a customer who recognizes the advantages inherent in the SPACE-MISER design.

Mr. J. C. Gardner, Westinghouse network transformer representative at the Sharon, Pa., plant, illustrates the relative size of the outstanding SPACE-MISER.



EEI-NEMA STANDARDS
for
SECONDARY NETWORK
TRANSFORMERS

New EEI-NEMA Standards result in savings to the user of network transformers. Westinghouse was active in the leadership to promote these standards.

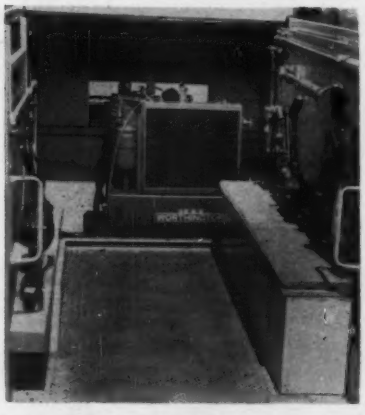
YOU CAN BE SURE...IF IT'S Westinghouse

S. M. Smith Has Order

(*Continued From Page* 81)

electric project of Southern California Edison Co.

The maximum static head difference between the upstream reservoir and the tailrace below the power plant is 1110 ft. Maximum net operating head on the turbines under normal conditions is 1009 ft. Each unit is rated at 88,000 hp at a speed of 360 rpm under an average net head of 950 ft. The turbines are of the vertical shaft type, with shop-welded plate steel spiral cases.



Worthington Exhibits 125-Cfm Rotary Compressor

A truck-mounted power take-off rotary compressor, developed as a result of research among utility users, is being marketed by Worthington Corp, Harrison, N. J. Built by the Holyoke Division, this 125-cfm, 100-lb unit is reported to be 60% lighter and takes 40% less space than conventional reciprocating machines.

W. H. Wheeler, manager of sales at Holyoke, stated, when given the green light the engineers developed and job-tested the compressor in one year.

For equipment demonstration, the self-contained belt-driven rotary compressor is mounted on a J. H. Holan Corp utility truck body. Included are air tools such as a trench digger, asphalt breaker, pole tamper and rock drill.

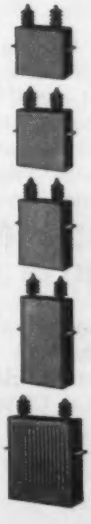
The mobile exhibit is scheduled for a tour in more than 50 cities across the country. The tour starts from Newark, N. J., arriving on the West Coast about Nov 1. Some scheduled exhibits are: Weeks of

99.6% SURE

Of all manufacturers of power capacitors only C-D puts each and every unit through a full voltage energization test before shipment to you. This is why C-D delivers an unbeatable 99.6%-sure performance

PERFORMANCE

in the field.



15, 25, 33.3, 50 and 100 KVAR capacitors for every application with lowest dielectric unit stress and highest major insulation level. Invest your purchasing dollar in internal quality—the only place where it counts. See your C-D representative or write Cornell-Dubilier Electric Corp., Dept. EW-7, South Plainfield, N. J.

SPECIFY

Consistently *Dependable*

CORNELL-DUBILIER

POWER-FACTOR CAPACITORS

Whether it's tool belts or safety straps . . . pliers or wrenches . . . grips or climbers, linemen and electricians know they can expect the highest in quality when their equipment carries the name Klein.

For more than a century Klein has been the leader in designing and producing tools and equipment to serve the exacting needs of the utility field.

Today, wherever power lines or communication lines are strung, Klein tools and equipment are in greater demand than ever, assuring safer, speedier line construction and operation.

WRITE FOR FREE TOOL GUIDE
A free copy of the new Klein Pocket Tool Guide will be sent on request.

ASK YOUR SUPPLIER
Foreign Distributor: International Standard Electric Corp., New York

Mathias KLEIN & Sons

July 14 and 21—High Point, Gastonia, Charlotte, N. C., Columbia, S. C., Atlanta Ga., and Birmingham, Ala., July 28—New Orleans and Baton Rouge; month of August—Lafayette, Lake Charles, Shreveport, La., Houston, San Antonio and Fort Worth, Texas.

Plant Expansions

• A permanent plant was started recently for General Electric computer department at Phoenix, Ariz. The department's million-dollar, 104,000 sq ft plant is expected to be completed in December. H. R. Oldfield, Jr. is general manager.

• A continuous-process asbestos-cement pipe plant, reportedly the first in U. S., was opened June 20 by Johns-Manville Corp at Denison, Texas. This Transite pipe plant is one of eight being brought into production during 1958—the company's 100th anniversary.

• Repair of power transformers, generators, motors and control plus manufacture or modification of similar specialized equipment will be the services provided in a 22,000-sq ft building opened June 19 by Westinghouse Electric Corp in Kansas City, Mo. It is to serve industry in Missouri, Kansas, Oklahoma, and Nebraska.

• To provide new, modern office space, Allis Chalmers Mfg Co, Milwaukee, Wis., has constructed a seven-story office building in West Allis, Wis. The building has 110,000 sq ft of floor space and provides office space for over 800 employees. It is occupied by Industrial and Community Relations, Public Relations and the Comptroller's and International Divisions.

• Seven new research and development laboratories and extensive new research facilities at four other existing laboratories have been included in a five-year $60 million research program of the Union Carbide Corp, New York, N. Y.

• Servicing and repair of electrical and mechanical apparatus will be provided in a 62,600 sq ft manufacturing and repair plant being constructed for Westinghouse Electric Corp in Glassport, Pa. An office building will adjoin the plant.

Manufacturers Briefs

Moloney Electric Co, St. Louis, has a new line of pole type distribution transformers in production, featuring lower exciting current, lower impedance, improved regulation and lighter weight.

Aluminum Co of America plans to begin aluminum production in two new potlines at Massena, N. Y. in September or October. These lines will have an initial total annual capacity of 54,000 tons. Two potlines are to be reactivated providing an additional 36,000 tons of aluminum per year.

Blaw-Knox Co, Erie, Pa., will supply 138 Vulcan soot blowers for a 1,715,000-lb-per-hr Unit 8 at the Avon Station of the Cleveland Electric Illuminating Co, Cleveland, O. Air will be the blowing medium and will be furnished by an automatically controlled centrifugal compressor. Station service pressure will be reduced to 125 psi. The compressor is a 9,160-rpm, 7,000-cfm, 2-cylinder machine with intercooling, driven by a 2,500-hp motor.

National Electric Products Corp, Pittsburgh, Pa., has an affiliate company, Bennett Associates, Inc, No. 2 Gateway Center, Pittsburgh. It is an exclusive representative for the sale of National's electric distribution materials in the United States, effective July 1. The affiliate is headed by National's General Vice President, R. C. Bennett, Jr., who remains on the Board of Directors and the Executive Committee of National Electric.

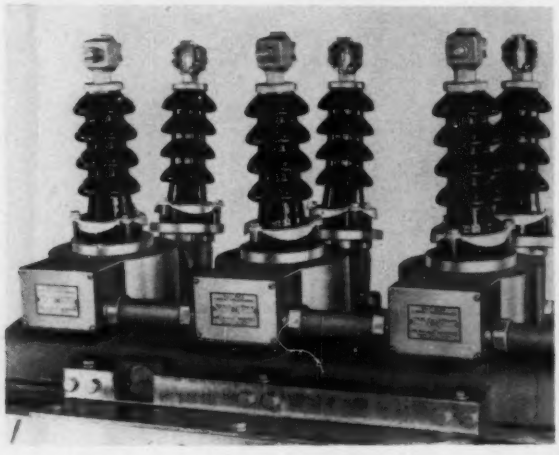
This scene of a transition from overhead to underground lines is typical of thousands of others that exist and are being planned to help make more hazard free traffic lanes. At most of these transition points you'll find a few inconspicuous G&W potheads. Their equally inconspicuous features play an important part in their contribution to making more hazard free traffic lanes . . . and power lines.

Type ST potheads provide the safest seal for the cable ends. They eliminate the risk of improperly assembling gasketed joints in the field. Factory assembly of safe metal-to-porcelain soldered (no gaskets) joints places the responsibility of properly sealed joints with G&W. Important also in combating hazardous conditions are the fine textured, spun copper wiping sleeve and top hood that eliminate the possibility of porosity in castings usually used in potheads.

Be safe—request Bulletin AA56 for help in specifying ST potheads for cables up to 69 KV and 2500 MCM.

G&W ELECTRIC SPECIALTY COMPANY
3500 W. 127th ST., BLUE ISLAND, ILLINOIS

A582



Bushing-Type CT's . . .

. . . are now available for Kyle Type R or W reclosers. These compact, weatherproof units are for external installation. Tap connections are brought out to convenient terminals, permitting simple selection of turns ratios of 100, 200, 300, 400, 500, or 600 to 5. Secondary thermal rating is 7.5 amp. Secondary windings are fully distributed on all ratios. Core and coils are encased in epoxy resin and covered with aluminum. Six current transformers can be installed on one recloser. Kits are available for installation on reclosers already in service.

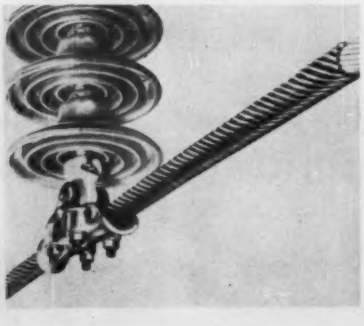
Line Material Industries, Milwaukee 1, Wis.

Dielectric Test Sets . . .

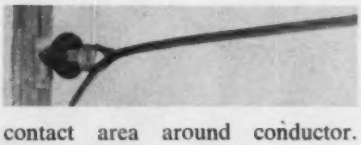
. . . include ratings from 20 to 350 kv and 2 to 1,000 kva. Each test set is complete unit, including controls and meters, autotransformer or regulator to vary input voltage, and high voltage testing transformer. Smaller ratings have all three components in single cabinet, which can be mounted on casters. Ratings between 50 and 150 kv, 5 to 25 kva, have separate HV transformer. Ratings above 150 kv, 25 kva are for stationary use only, with control console, regulator, and HV transformer in three separate units. For high voltage laboratory work, up to three 350-kv transformers can be cascaded to obtain more than one million v a.c.

General Electric Co, Schenectady 5, N. Y.

Preformed Accessories . . .



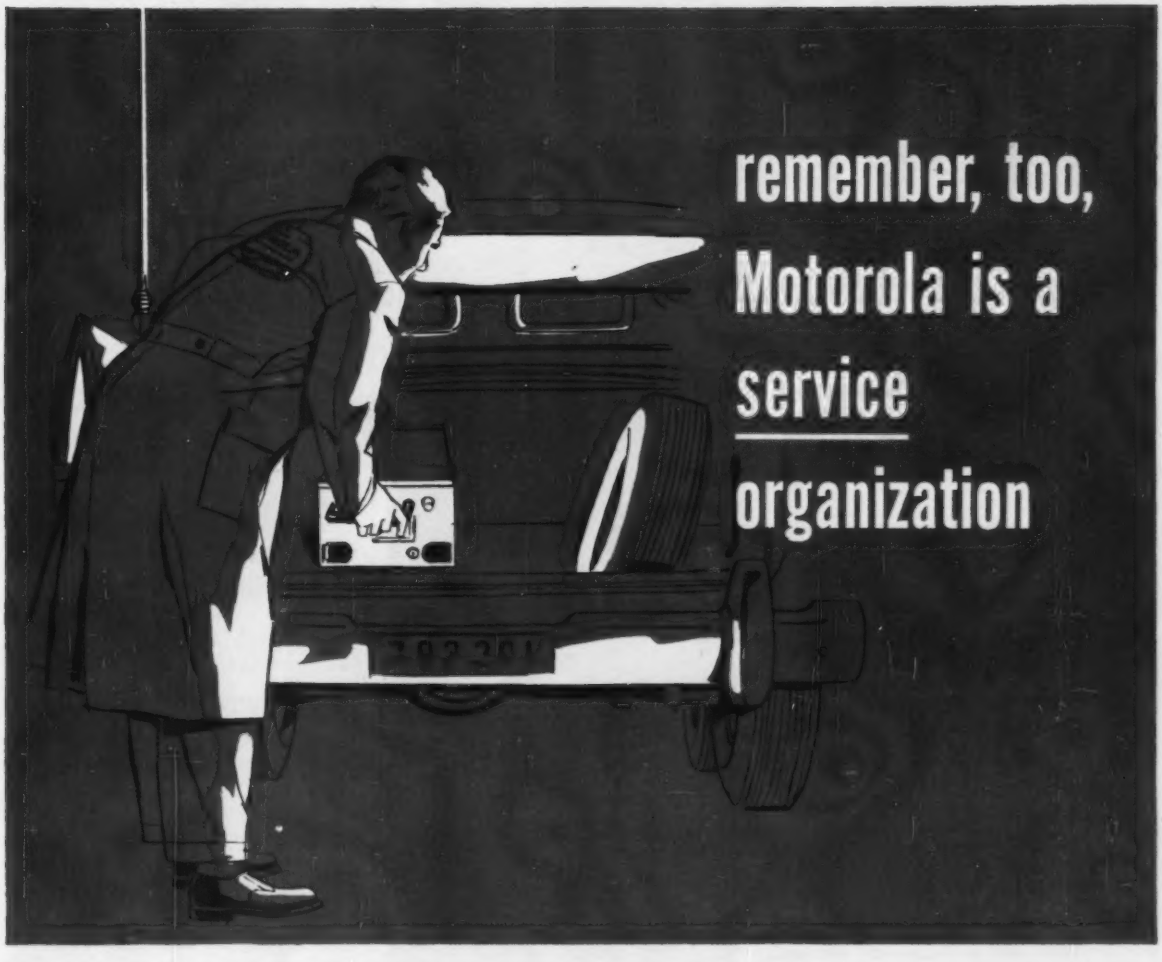
. . . include armor rods, line splices, dead-ends, and patch rods for Kaiser Triplex AC and Reynolds 5005 aluminum alloy conductors. Armor rods (left) fit specific conductor sizes. Spring contact between rod and conductor prevents relative motion and abrasion. Design maintains electrical and mechanical continuity if vibration causes conductor wire fatigue breakage at support point. Splices have large



contact area around conductor. Holding strength approaches ultimate breaking strength of conductors. Resistance across splices is lower than equivalent length of conductor. Low weight, small diameter, and flexibility permit them to pass through most stringing sheaves.

Dead-ends can be applied by

(*Continued on page* 90)



Motorola's National Service Organization is the largest nationwide service force *specially trained* to maintain 2-way radio systems to factory standards.

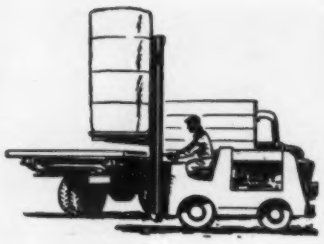
No matter how large your radio system is—how widely distributed the mobile units are—Motorola can provide system maintenance specifically tailored to your requirements. The Motorola field service organization and 800 Authorized Service Stations are your guarantee of dependable 2-way radio operation month-after-month, year-after-year.

MOTOROLA

2-WAY RADIO

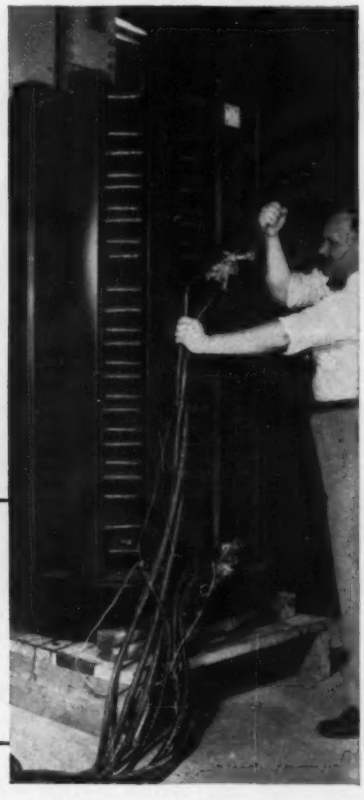
MOTOROLA COMMUNICATIONS & ELECTRONICS, INC.
A SUBSIDIARY OF MOTOROLA INC.
4501 AUGUSTA BOULEVARD • CHICAGO 51, ILLINOIS

For the finest radio communications equipment, as well as the most reliable system maintenance, see Motorola, world's largest exclusive electronics manufacturer and leading supplier of 2-way radio.



from Board to Installation, only...

8 week delivery on Murray Cast-in-Concrete Reactors



- Single, two and three phase
- Air core, air cooled, dry type
- Aluminum or copper conductors
- Wet steam-cured concrete posts
- Non-aging glass insulated cable
- Metal enclosures available

No matter whether you need a standard design or a special purpose reactor, Murray can deliver within 8 weeks if necessary.

Backed by almost 50 years of experience serving the utility and heavy industries, Murray current-limiting reactors have achieved a reputation for maximum dependability, minimum maintenance, quick delivery.

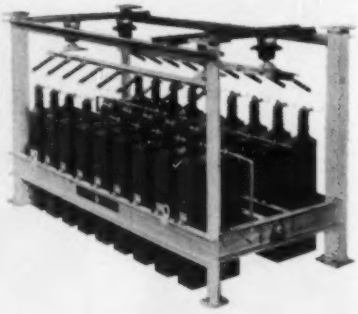
Engineered to your specifications for indoor or outdoor service, competitively priced Murray reactors are available for generator, bus tie, station tie, feeder, motor starting, shunt and neutral grounding service. Also available are such types as laboratory test, wave trap, and other special purpose reactors.

Whatever your reactor needs are, you can depend on Murray to fulfill them dependably and quickly. For further information, write Reactor Division, Murray Manufacturing Corp., 1250 Atlantic Avenue, Brooklyn 16, N. Y.

Murray **murray**
ELECTRICAL DISTRIBUTION EQUIPMENT

(*Continued from page* 88)

hand, without special tools. Gripping strength approaches ultimate conductor breaking strength. Applied over damaged area, patch rods will repair up to 25% of mechanical and electrical strength of outer layer of conductor.
Preformed Line Products, 5349 St Clair Ave, Cleveland 3, Ohio



Aluminum Stack Racks . . .

. . . assembled with 50-kvar capacitors, fuse holders and bus work, are 15 to 25% lighter than racks with galvanized steel construction. Designed to supply bulk kvar on transmission, subtransmission, and distribution circuits, these units require less installation time and reduce strain on base and stack insulators. Racks do not require painting, even in industrial or coastal areas. Equipments are available with 8 to 24 capacitors, supplying 400 to 1,200 kvar, and may be used on circuits rated 2.4 kv and up. Partially assembled, 8-ft high, aluminum substructures to elevate racks are also available.
Preformed Line Products, 5349 St. N. Y.

Al-Cu Adapter . . .

. . . used with copper transformer terminals or bimetallic secondary taps consists of aluminum compression sleeve bonded to 7-in. length of plated, soft-drawn, solid copper

(*Continued on page* 92)

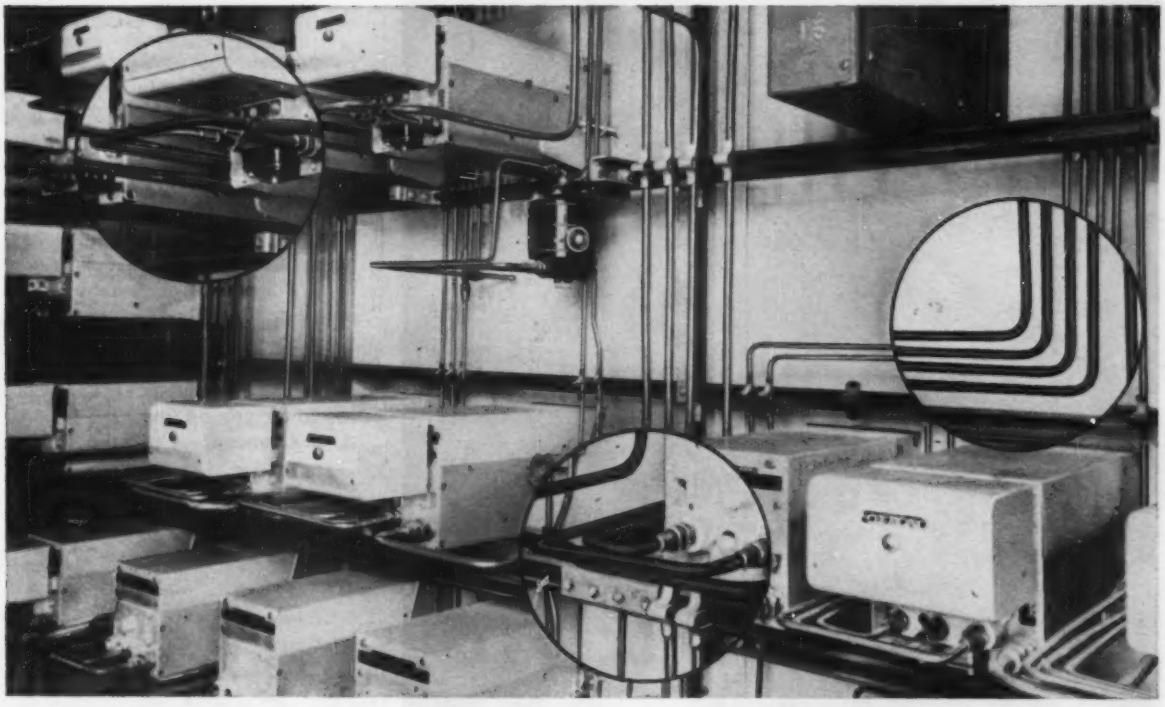
SAFETY m.i.
INDUSTRIAL WIRING CABLE

EASIEST TO INSTALL:

Safety m.i. Cable needs no raceway or other protection... trains easily anywhere, even around irregular contours... small diameter ... light weight.

TOUGHEST EVER MADE:

Safety m.i. Cable is tough, rugged, and practically indestructible ... can be operated continuously at high temperatures... will not burn... resists aging, water, steam, chemicals, oils, and greases.

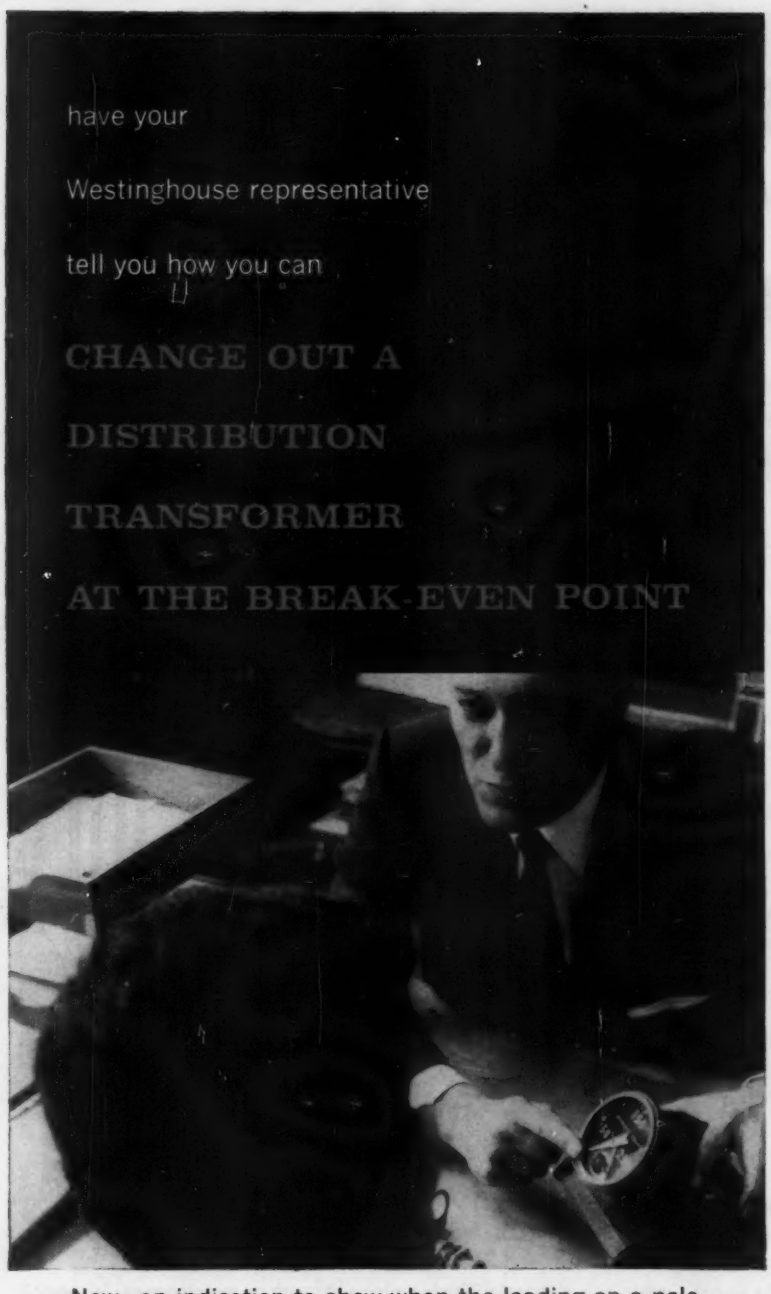


THROUGHOUT INDUSTRY General Cable's Safety m.i. Cable is in use in distribution, control and lighting circuits up to 600 volts. Leading industries include oil, chemical, steel, automotive, paper, glass, utilities, and railroads. In general applications Safety m.i. offers easy installation, neat appearance, easy training around obstacles, complete dependability for a long life with no maintenance. In special applications, "m.i." offers the additional advantages of a fully-insulated, self-contained wiring system which eliminates vapor passage. For truly modern industrial wiring specify "Safety m.i. Cable."

Available in 1, 2, 3, 4, and 7 conductor for power and control circuits.

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N. Y.
Offices and Distributing Centers Coast-to-Coast

for quality and service... **specify GENERAL CABLE**



Now—an indication to show when the loading on a pole-type distribution transformer has reached economical change-out point on conventional or protected units . . . Another answer to meet a changing need—made possible because Plowback of earnings into research maintains Westinghouse leadership in distribution transformer development.

J-70847

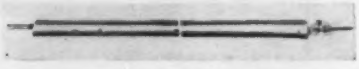
YOU CAN BE SURE...IF IT'S

Westinghouse

(*Continued from page* 90)

wire. The ACA is available in three ½-in. and five ⅝-in. sleeve sizes. Equipped with either No. 4 or No. 2 copper rods, these adapters are designed to handle No. 4, and No. 2, and 1/0 ACSR cables. Plating on copper rod provides corrosion free junction between copper and aluminum. Adapters are color-coded and indent marked for size identification. Sleeves are pre-filled with inhibitor.

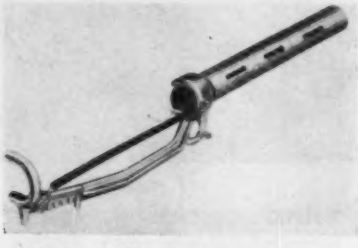
Anderson Electric Corp, Birmingham 1, Ala.



Aluminum Guy Guard . . .

. . . retains high visibility even under corrosive conditions. Designed for quick installation, these 16-gauge guards are available in 7- and 8-ft half-round style. Turned-in edges provide additional strength and safety. Bolt-and-keeper fastener at bottom attaches between guy wires leading from rod eye to guy-wire clamp or through the eye of a preformed grip. Tight gripping, non-scarring hook on top attaches to guy wire. Guard has three holes which permit adjustment to cover anchor rod to the ground line.

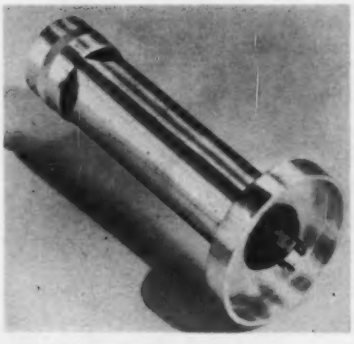
A. B. Chance Co, Centralia, Mo.



Cable Lasher . . .

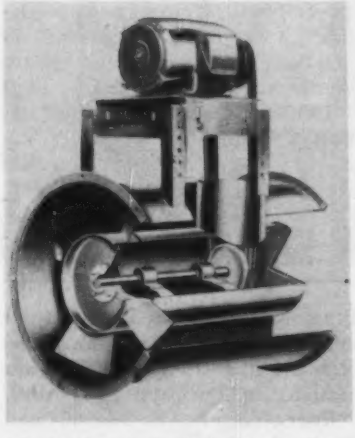
. . . handles cables up to 1.25-in. diam with messengers up to $\frac{5}{16}$ in. Unit consists of lashing tool and 2-in. tube containing 150 ft of pre-coiled lashing wire. Spans of any length can be handled but sufficient lashing wire to finish the job must be around messenger when starting. Additional coils must be spliced to first coil at beginning of operation. Cable guide is used when larger

cables are being lashed to support cable and facilitate operation.
Hubbard & Co., 6301 Butler St, Pittsburgh 1, Pa.



Streetlight Control . . .

. . . can be adjusted to operate at daylight levels between ½ and 100 ft-c. This No. 3158 Floodlight Control controls 2 kw of neon or fluorescent lamps, 1 kw of incandescent, or, by using a power contactor, a bank of lights of unlimited load. Three-contact, twist-lock base simplifies installation. Bases with pigtail connections are also available. Unit uses no vacuum tubes and has hermetic, tungsten-to-mercury contacts. It can be installed at up to a 30-deg angle and is not affected by temperature changes.
Roth Mfg Co, 6420 W. Howard St, Chicago 31, Ill.



Motorized Axial Flow Fans

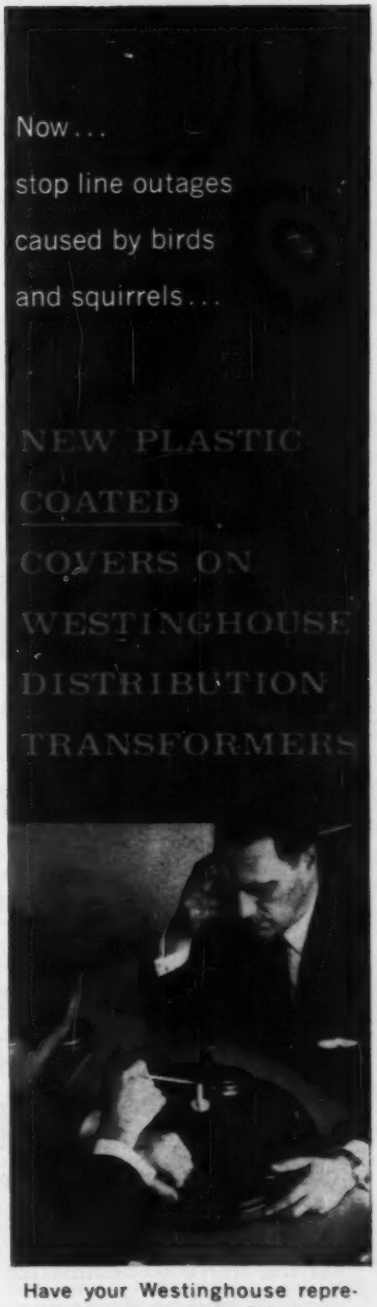
. . . mount directly in ducts and stacks of exhaust or supply systems. These Series 300 Tubeaxial fans are offered in seven sizes for inside diameters from 18 to 42 in. and include ratings from 2,410 to 36,700 cfm. Rugged and dependable, they are designed for simple application of corrosion-resistant coatings or for construction with special metals. Separate fan and motor platforms are eliminated. Anchored shaft design permits universal mounting in horizontal or vertical stacks. Adjustment of belt tension and bearing lubrication can be performed externally.
Westinghouse Sturtevant Div, Dept T-187, Readville St, Hyde Park, Boston 36, Mass.

CT Comparator . . .

. . . with vernier dials is easily read. This Type CTC-3 portable unit has self-contained ammeter, with 1, 10, and 20-amp ranges, which imposes burden of less than 0.1 va on transformers. It includes detector for wrong polarity or other improper connections. Ratio error and phase angle are measured simultaneously and are direct reading. Full-scale error range is 0.64% in ratio error, with 0.01% divisions, and 35 min in phase angle, with one-min divisions. Overall accuracy is within one-half division for secondary currents from 0.5 to 20 amp. Unit is free from effects of stray fields, harmonics, and heavy overload test currents.
Knopp, Inc, 1307 66th St, Oakland 8, Cal.

Portable Power Coiler . . .

. . . measures and coils electric cable quickly and neatly. Designated the Reel-O-Matic Model C, it can pull cable from one-ton supply reel at rate of 20 rpm. Frame is welded construction. Unit is powered by ½-hp, 110-v, capacitor-start motor. Accessory turntable permits coil-to-coil cuts. Unit may be bolted to special base to permit rewinding on large wooden reels. Larger models and variable speed double spindle coilers are also offered in the same design.
Columbia Products, Inc, Wrightsville, Pa.



HAVE PRODUCTS...WILL TRAVEL!

(over 20,000 miles to be exact)

When you've got products that need showing, put 'em on wheels and roll!

That's exactly what Royal is doing with this unique mobile display throughout the United States.

Royal's new Aluminum Power Connectors and Welding Fittings, plus the entirely new RVL Group Operated Switch will be shown to power companies in more than 100 cities. An informative sound slide film accompanying the demonstration will tell the development story of Royal Aluminum Power Connectors.

From Maine to California, Seattle to Miami, Royal is on the move to familiarize the industry with its many services and products.

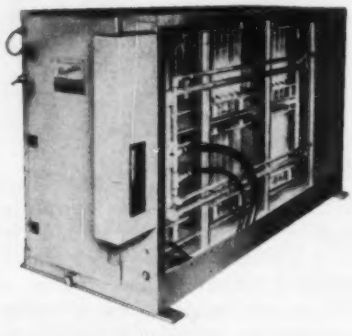
ROYAL

A part of the arsenal of AMERICAN POWER PRODUCTION

ROYAL ELECTRIC MANUFACTURING CO., INC.
1122 EAST 87TH STREET • CHICAGO 19, ILLINOIS
Designers and Manufacturers of Power Switching Equipment and Special Electrical Devices

Cable Ladder . . .

. . . for semi-rigid and armored cables is made of aluminum to reduce weight, simplify installation, and provide additional corrosion resistance. Ladder comes in sections for easy installation and has perforated cross members for securing cables.
T. J. Cope Div, Rome Cable Corp, Collegeville, Pa.



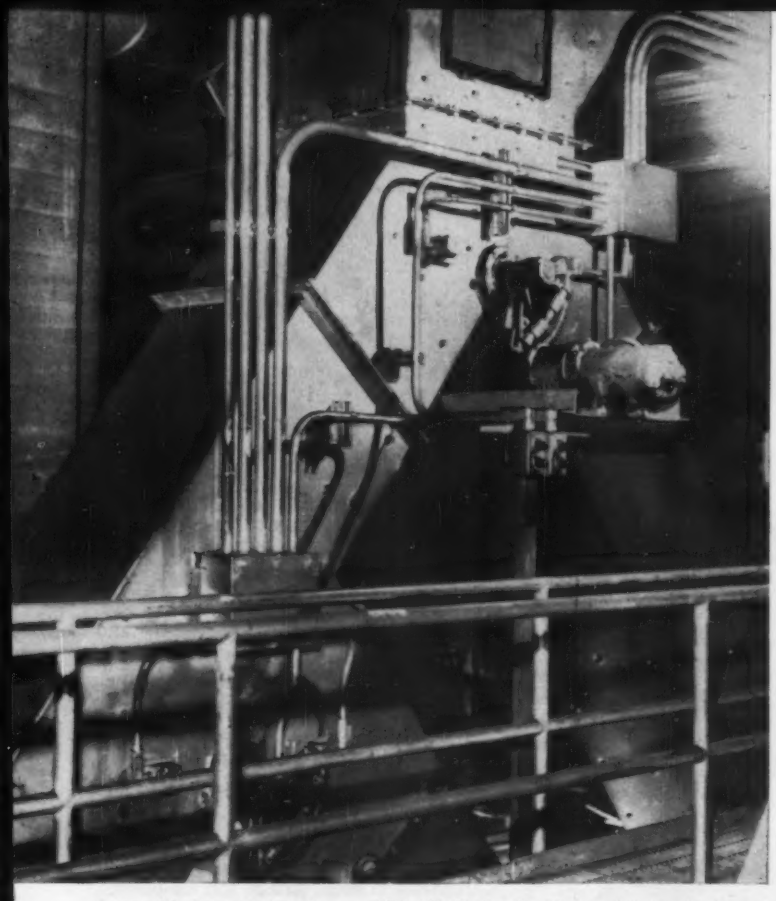
Automatic Air Cleaners . . .

. . . are offered in sizes from 1,920 to 28,800 cfm. Motorized traverse washer flushes out collected dirt from metal collector plates and sprays on new coating of cold water adhesive. Entire cycle of stopping fans, washing, and returning to normal operation may be controlled either by pushbutton sequencing controller or by optional clock control which operates at intervals from 2 to 21 days. These Model PG cleaners are packaged units and are designed for easy in-line installation with other Sturtevant ventilation and air conditioning systems.
Westinghouse Sturtevant Div, Dept T-190, 200 Readville St, Hyde Park, Boston 36, Mass.

More New Products

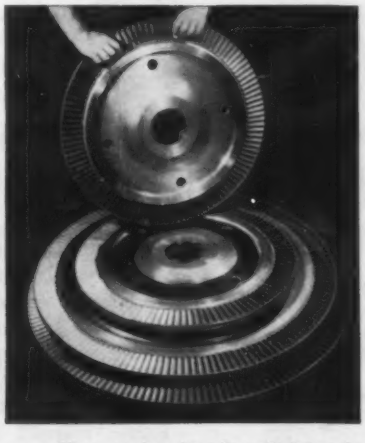
Brascolite **luminaires** for industrial applications using both incandescent and mercury vapor lamps are available in low bays, glass Alzak diffusers, deep bowls, 30-, 60- and 90-deg beam high bays and mercury vapor high bay units.—The Edwin F. Guth Co, St. Louis 3, Mo.

(*More New Equipment on page* 96)



Longer life for coal chute liners. USS "T-1" Steel's high resistance to impact abrasion has doubled, tripled and even quadrupled the life of chutes handling highly abrasive materials such as coal, cinders and ore. "T-1" Steel furnished to 321 minimum Brinell has been particularly effective in this service.

Over a ton of weight saved on this lighter-weight portable transformer. Shell thickness was reduced from ⅜ to ¼ inch by designing to USS "T-1" Steel's greater strength.



60 per cent savings in material costs were realized by making these small turbine rotor discs from USS "T-1" Steel which has a yield strength of 100,000 psi minimum.

How USS "T-1" Steel is used for **cost reduction** in power plants

Power plants are caught in the cost squeeze like every other industry. But if you can make your equipment last longer by using better steel, you can save a substantial number of dollars.

USS "T-1"* Constructional Alloy Steel has an amazing combination of properties that can cut costs in numerous ways:

- **Minimum yield strength of 100,000 psi NRM—permits stronger construction with large savings in weight.**
- **Outstanding resistance to impact abrasion—increases equipment life.**
- **Exceptional toughness even at 50° below zero temperature—reduces maintenance costs.**
- **The 4 times greater atmospheric corrosion resistance increases service life.**
- **Ready weldability and formability—reduces construction costs.**
- **Lower transportation charges—because fewer tons are shipped to job sites.**

All this means that materials handling equipment can last two or three times longer when built of USS* "T-1" Steel. And wherever impact abrasion is particularly severe, USS "T-1" Steel may be furnished quenched and tempered to 321 minimum Brinell hardness for maximum performance.

Other savings have shown up in a variety of ways—lighter construction, lower fabrication costs, smaller foundations, considerably less maintenance, fewer outages, less freight and lower erection costs.

Consider USS "T-1" Steel for use in handling and storage equipment, pressure vessels, scroll cases, penstocks. Write for our book, *USS "T-1"*, which gives the complete story. United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

Immediate Delivery. Our new continuous plate heat-treating line offers solution to your delivery and quality requirements. Therefore, there is no tonnage restriction on plates, and as little as three tons of "T-1" Steel bars may be purchased directly from the mill.

*TRADEMARK

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

Drop Forged Aluminum and Steel

BTC **Suspension Clamps**

Long Conductor Life Insurance
No excessive wear on connecting surfaces
No bore size allowance necessary
Wide range of sizes
Specify the best—BTC Hi-Line Hardware

THE BREWER-TITCHENER CORPORATION
HI-LINE HARDWARE DIVISION • CORTLAND, N.Y.

Distribution panel board **standoff insulator** for systems up to 600-v simplifies bus supports on steel framework and offers savings in materials cost. Made from arc and flame-resistant compound for continuous service to 300F.—The Glastic Corp, 4321 Glenridge Rd, Cleveland 21, Ohio.

Machine **load control** protects equipment against overload, underload, no-load and phase failure through automatic shut-off, automatic warning, and/or continuous on-off automatic operation. Two separate contact ammeters are activated by a current transformer.—Tipptronic, Inc, Chagrin Falls, Ohio.

Dust-tight EN116, 117, 216 and 217 Powerstat **variable transformers** feature simple installation and accessibility. Ratings from 2.6 to 8.5-amp constant-current load with up to 12.5-amp constant-impedance lead. Data sheet SE-L2581.—The Superior Electric Co, Dept EN, Bristol, Conn.

Metal content **brush** for tin-plating and similar applications has seamless tube of insulating material, sealed at brush and terminal to completely protect copper shunt from corrosive fumes or electrolytic bath splashes.—The Ohio Carbon Co, 12508 Berea Rd, Dept 78, Cleveland 11, Ohio.

Self-mending wire mesh **surface heating element,** with 36 parallel heating circuits, provides even surface temperature and maintains performance even when damaged, by redistributing current flow through intact circuits. Operates at voltages from 6 v dc to 220 v ac, with ratings from 10 to 35 w per sq in. Bulletin 6010.—Electrofilm Inc, Box 106, North Hollywood, Calif.

Type MT motor-powered tractor for overhead tramrail materials handling systems can be used for single motor drive for one or more carriers in a train. Minimum speeds are, 50 fpm with a ½-hp motor; 75 fpm with a ¾-hp motor; and 100 fpm with a 1, 1.5, or 2-hp motor. Maximum speed is 350 fpm.—The Cleveland Crane & Engineering Co, Wickliffe, Ohio.

new symmetrical interrupting ratings for XS Cutouts adjust lab results to field conditions

S&C matches actual ratings to system short-circuit calculations—

To simplify application, S&C has now provided symmetrical ratings for its distribution cutouts.

These new symmetrical ratings are provided because asymmetrical ratings are based on total available short-circuit current of the circuit, including the DC component. The asymmetrical ratings furnish a uniform, standardized measure of cutout performance, but they cannot, of course, be used directly in matching cutouts to system short-circuit calculations which yield *symmetrical* values.

The new symmetrical ratings bridge the gap and eliminate the possibility of "underprotecting" the system with a cutout of inadequate interrupting capacity, or "overprotecting" with a cutout of unnecessarily high interrupting capacity.

To arrive at a nominal set of symmetrical ratings, specific X/R ratios are assumed for the Heavy Duty XS and the Extra Heavy Duty XS,—8 and 12 respectively—typical of the conditions at locations where each of these cutouts is applied (see table at right).

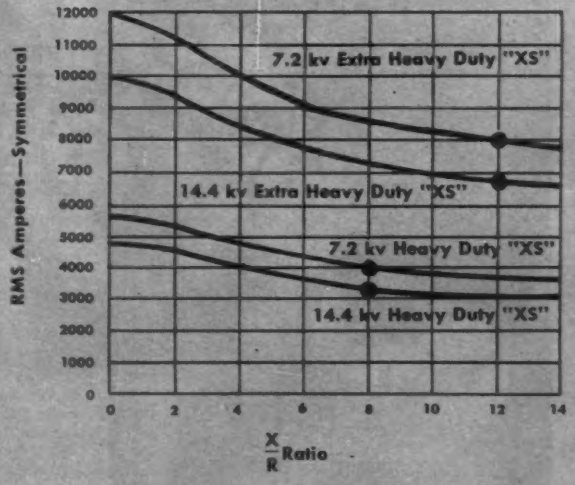
To enable the distribution engineer to take advantage of more favorable conditions—that is, where the X/R may be lower—special adjustment curves (shown to the right) are provided. These curves indicate the symmetrical interrupting ratings of the XS at other X/R ratios. (Those at 0 are the *actual* asymmetrical interrupting capacities of the XS, which may differ from the *nominal* asymmetrical ratings per NEMA standards.)

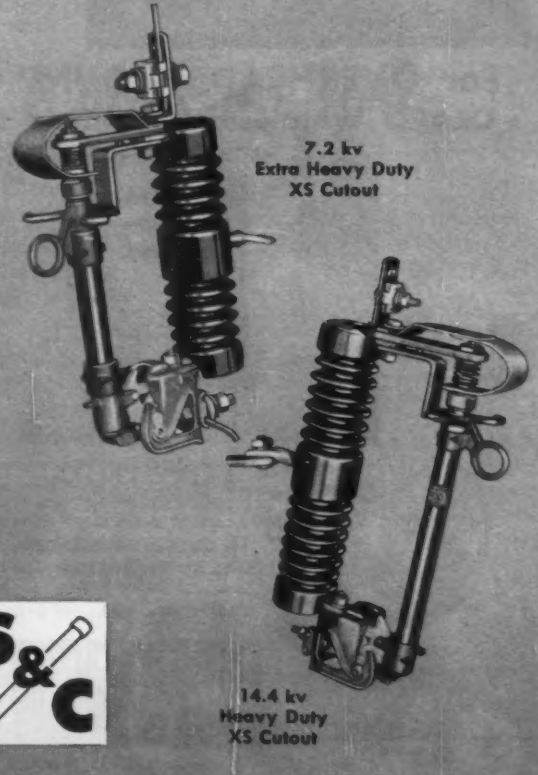
For further information, write for Descriptive Bulletin 511—providing full data on the XS Cutout—to S&C Electric Company, 4421 Ravenswood Ave., Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.

50/60 Cycle Short-Circuit "Nominal" Interrupting Ratings

Nominal Ratings kv	Amperes, RMS			
	Heavy Duty "XS"		Extra Heavy Duty "XS"	
	Asymmetrical	Symmetrical	Asymmetrical	Symmetrical
7.2	5000	4000	12000	8000
14.4	4000	3300	10000	6700

Adjustment Curves for Symmetrical Interrupting Ratings of XS Cutouts at various X/R Ratios.





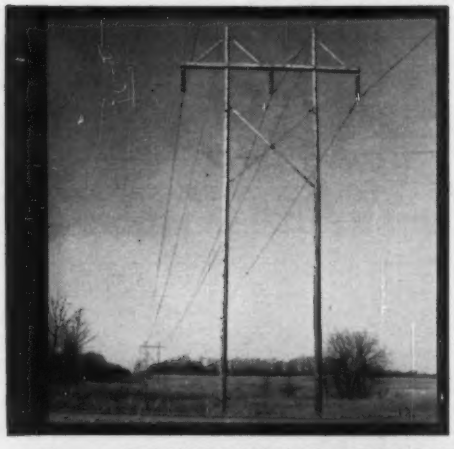
7.2 kv Extra Heavy Duty XS Cutout

14.4 kv Heavy Duty XS Cutout

S&C ELECTRIC COMPANY

Power Fuses · Tool-Operated Disconnects · Open and Enclosed Cutouts · Load Interrupters · Metalclad Switchgear · "Loadbuster"

GALVANIZED STEEL STRAND

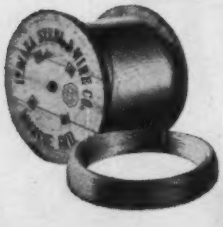


YOUR ASSURANCE OF HIGH QUALITY, LONG LIFE AND LOW COST

Close laboratory control over each step in manufacture has established Crapo Galvanized Steel Strand as a product of highest quality and dependability. You benefit through longer service life and lower ultimate costs.

Heavy, uniform, tightly-bonded coatings of commercially pure zinc, applied by the famous Crapo methods, withstand the punishment of construction, provide maximum resistance to corrosion and contribute to over-all economies.

For OVERHEAD GROUND WIRE . . .
CRAPO Weldless Galvanized Steel Strand



The most practical and economical strand for shielding transmission lines against lightning. Maximum strength and high fatigue endurance, inherent in Crapo Weldless Strand, provide that extra safety factor so important in overhead ground or static wire.

For GUYS and MESSENGER . . .
Crapo Galvanized Steel Strand. Made to highest standard specifications . . . a size and breaking strength to meet all practical needs.

Contact your jobber or write for descriptive folder.

INDIANA STEEL & WIRE CO., INC.
Muncie, Indiana

NEW LITERATURE

• **ALUMINUM CONDUCTORS:** 88-p booklet, "Aluminum Electrical Conductors—General Engineering Data" lists 4,000 sag and tension charts, including almost every type of covered and bare aluminum conductor. Aluminum conductors are listed by code name in a glossary. Aluminum Co of America, 1501 Alcoa Bldg, Pittsburgh 19, Pa.

• **HEATING UNITS:** Precision cartridge heating units and ceramic heating units are described in a 12-p catalog 200A. Hotwatt Inc, 16 Gould St, Danvers, Mass.

• **PLASTIC CONDUIT:** 4-p brochure tells of types and applications of plastic lines, single or multiple installations. Southwest Plastic Pipe Co, Box 117, Mineral Wells, Tex.

• **INSULATION PRODUCTS:** 16-p catalog, No. 24, describes Standard Packaged slot insulations, formed fibre and shaped wood wedges and fibre washer kits, with selection guides. Insulation Manufacturers Corp, 565 W. Washington Blvd, Chicago 6, Ill.

• **TRANSFER SWITCH:** How to select an automatic transfer switch and application of this equipment are covered in a 24-p booklet 596-R1. Some case histories are given. Automatic Switch Co, Florham Park, N. J.

• **SLIDE RULES:** Rule provides a simple method to determine the sizes and catalog numbers of suspension clamps with preformed, tapered, and straight armor rods, high tension and pistol grip strain clamps and straight line dead-end clamps. Anderson Electric Corp, Birmingham 1, Ala.

Rule type calculator provides electrical and mechanical specifications on all standard continental connectors. Also has Body Moulding Comparator that provides values of various properties of plastic compounds. Electronic Sales Div, DeJur-Amsco Corp, 45-01 Northern Blvd, LIC, N. Y.

• **TRANSFORMERS:** Bulletin SL-703, 14 pp, gives design features and construction details of constant-current transformers. Moloney Electric Co, St. Louis 20, Mo.

• **AERIAL CABLES:** Series of papers on performance and protection of aerial cables, S-102, has been compiled in booklet form. $2.50. AIEE Order Dept, 33 W. 39th St, New York 18, N. Y.

• **LOADER:** Form UL-1-10M-458 details features and dimensions of a front-end loader. Ottawa Steel Div, Young Spring & Wire Corp, Ottawa, Kan.

(*More New Literature on page* 100)

Shown: New Dodge Tradesman—a pick-up with side lockers.

You get extra quality at no extra cost— Dodge is one of the low-priced 3!

You may be surprised to know, for instance, that a standard Dodge *Power Giant* V-8 pick-up costs $2.66 *less* than pick-up "F", and only $5.50 more than pick-up "C" . . . that a rugged Dodge *Power Giant* panel costs less than either panel "F" or panel "C"*. Yet Dodge *Power Giants* give you many more advantages, leading the low-priced three in all four important ways:

First in power! Discover the extra traffic pep and extra pulling power that you get from *Power Giant* V-8's, with up to 27.5% more power than competitive trucks.

First in payload! You'll find you get as much as ⅓ more payload per trip, because *Power Giant* construction adds extra strength without adding weight. You save trips, man-hours and fuel!

First in economy! In addition to low first cost, you save with exclusive Dodge Power-Dome V-8 engine design that gives you extra gas mileage and reduces power-robbing carbon deposits.

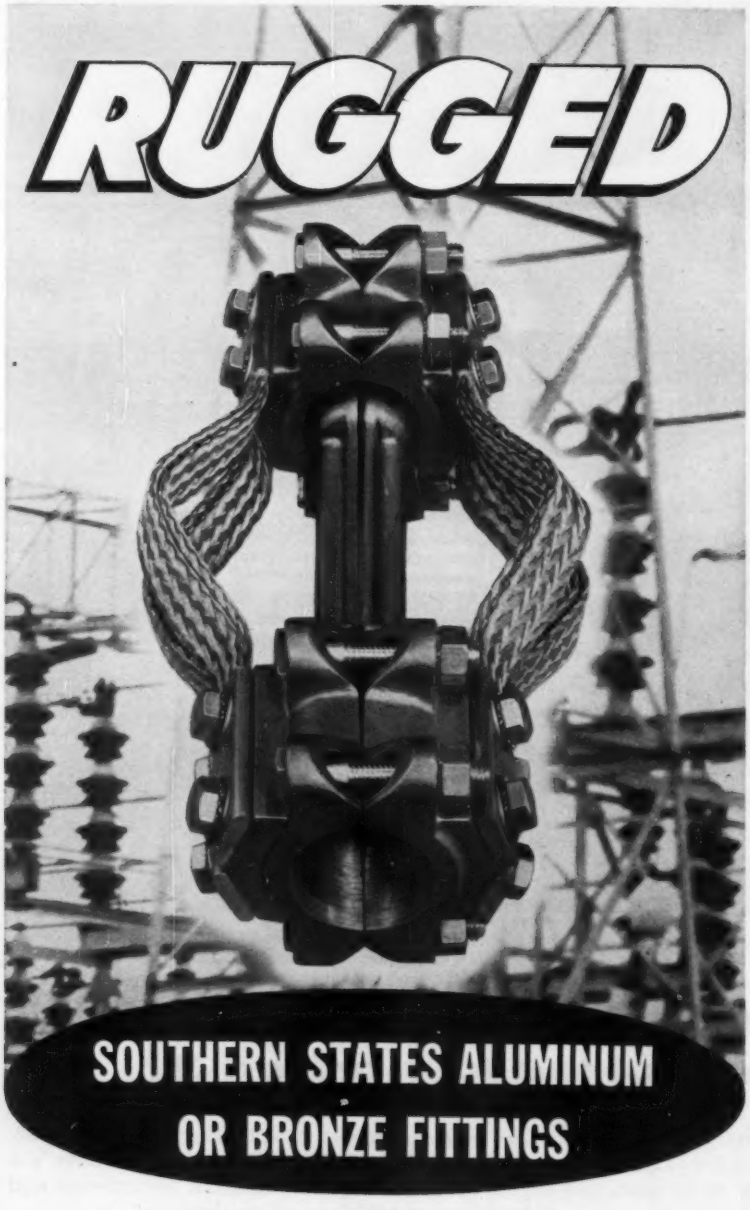
First in styling! Your business gets a prestige bonus with a Dodge *Power Giant*. Its striking dual headlights, massive new grille and flowing, sculptured lines set new truck styling trends.

Despite all their advantages, Dodge trucks are priced with the lowest. So before you buy any truck, look into these handsome, rugged new *Power Giants*. Compare *trucks*, and compare *prices*. See your Dodge dealer soon, and get his special 40th-Anniversary deal!

**Based on official factory-suggested retail V-8 prices.*

4-way leaders of the low-priced 3

DODGE *Power Giants*



Extra ruggedness at critical stress points receives special attention in the design of Southern States connectors. Ears and walls are husky enough to take the full squeeze of clamping bolts without visible distortion. This extra ruggedness, without excessive bulkiness or weight, is made possible by careful engineering design — backed by more than 25 years experience in producing connectors. *Never underestimate the importance of a good connection!*

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

• **ALUMINUM CONNECTORS:** Selection chart shows how to select a connector for a specific application. Delta Star Electric Div, H. K. Porter Company, Inc, 2437 Fulton St, Chicago 12, Ill.

• **BOLTED FRAMING:** 52-p catalog, 1-57, has design and specifications on bolted framing channel and fittings. Brinkley Mfg Co, Warrenton, Mo.

• **ANNUAL REPORT:** 1957 Annual Report of the National Bureau of Standards covers technical activities, administrative activities, publication, research and development program, calibration, testing and standard samples and cooperative activities of the Bureau. $0.45. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

• **EARTH ANCHORS:** 4-p catalog gives details and prices on expanding type earth anchors. Pieper-Lillard, Inc, 122 N. Kirkwood Rd, St. Louis 22, Mo.

• **MACHINE DESIGN:** Manual has techniques, charts, nomographs and data for redesigning from an existing casting or designing from calculated loads through use of welded steel design. $1.00. Lincoln Electric Co, 22801 St. Clair Ave, Cleveland 17, Ohio.

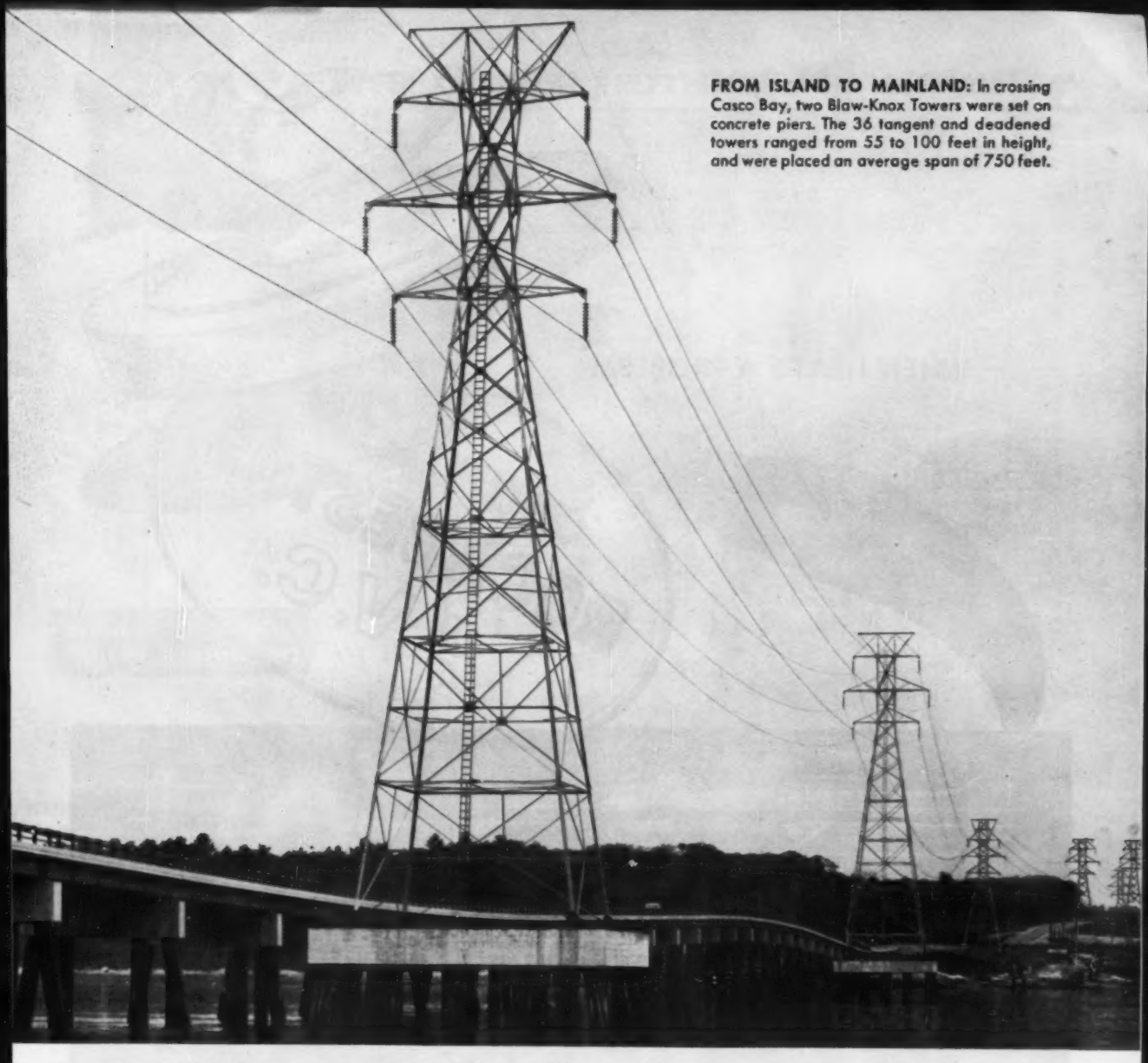
• **FEEDWATER REGULATOR:** Bulletin 1045 describes Flowmatic D-O feedwater regulator, explains through a schematic diagram the application principles of the feedwater regulator, and gives specifications of the various integrated parts. Copes-Vulcan Div, Blaw-Knox Co, Erie, Pa.

• **OVEN:** 4-p bulletin, 2299, describing "Equa-Therm" oven has a table which illustrates temperature differentials. American Instrument Co, Inc, 8030 Georgia Ave, Silver Spring, Md.

• **MICACEOUS INSULATION:** Bulletin A-58 gives characteristics and specifications of Isomica-Epoxy micaceous insulation for Class B electrical equipment. Mica Insulator Div, Minnesota Mining & Manufacturing Co, Schenectady, N. Y.

• **BRUSH CONTROL:** "Before Trouble Starts" discusses use of modern herbicide chemicals as a method of controlling vegetation along right of ways, in substations and storage yards. Also discusses various chemicals adapted to utilities' needs and application programs tailored to meet electrical company problems. Agricultural Chemical Sales, Dow Chemical Co, Midland, Mich.

• **PHOTOELECTRIC CELLS:** Complete line of photoelectric cells is described in 12-p bulletin, EPD 3216-1. Information included covers construction details, performance characteristics, power output charts, electrical current diagrams for typical applications and suggested uses in electrical and industrial engineering. Vickers, Inc, Electric Products Div, 1815 Locust St, St. Louis 3, Mo.



FROM ISLAND TO MAINLAND: In crossing Casco Bay, two Blaw-Knox Towers were set on concrete piers. The 36 tangent and deadened towers ranged from 55 to 100 feet in height, and were placed an average span of 750 feet.

Central Maine chooses Blaw-Knox Towers to carry lines from new Cousins Island Plant

The new Yarmouth Steam Plant—the newest and potentially the largest in Maine—is the latest development by Central Maine Power Company to meet the increased needs of its growing number of customers. The new showcase plant will use two 44,000 kw turbine-generators along with the latest and largest transformers and condensers in the state.

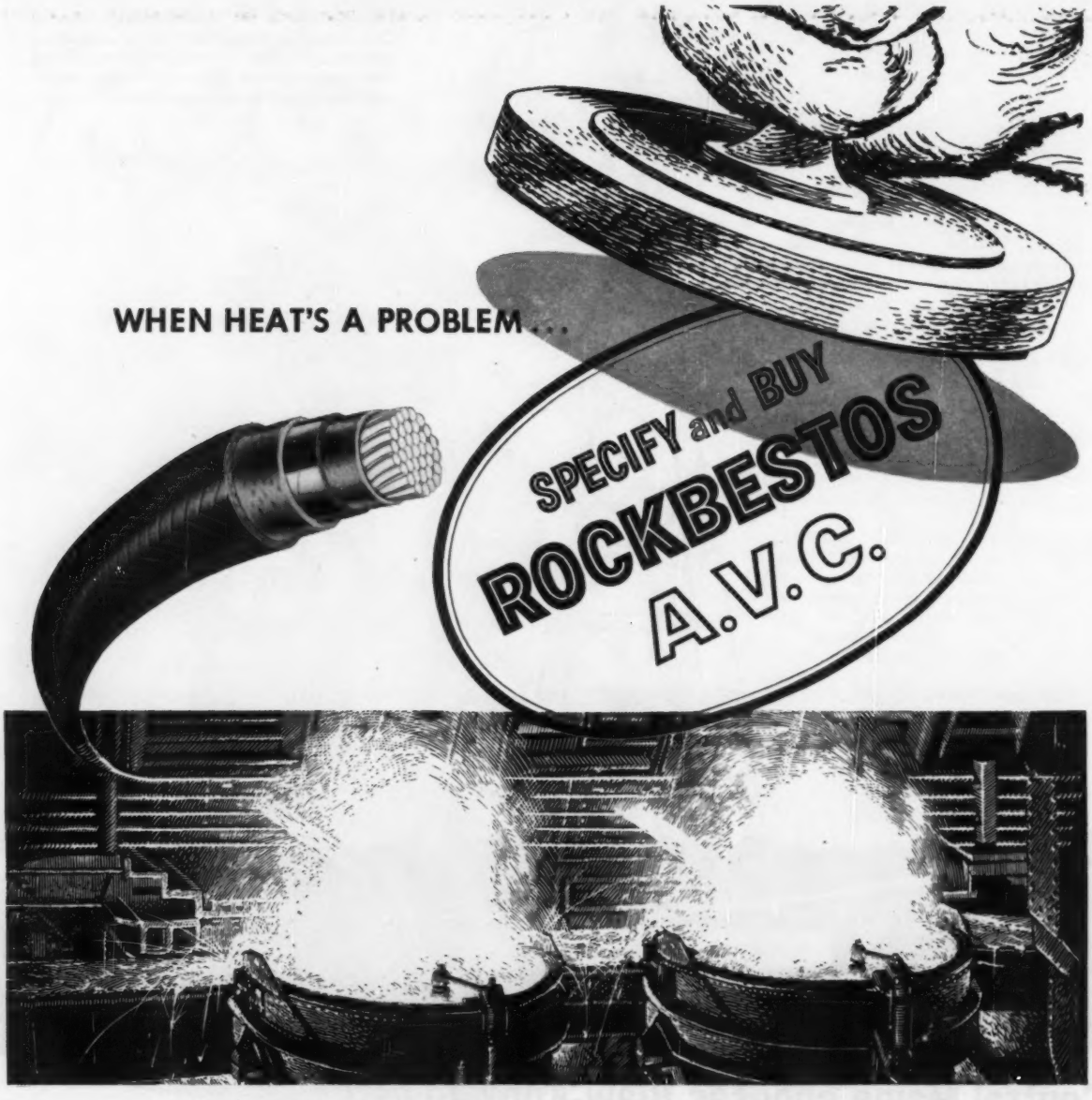
To carry the 115,000 volt lines from Cousins Island to the Moshers substation in Gorham, Blaw-Knox designed and fabricated 36 steel transmission towers. Working with Central Maine's engineers Blaw-Knox was able to bring over 40 years of transmission tower experience to the job. Basic concepts evolved from this extensive experience are used to build towers that are superior in strength, simpler to erect, easier to modify.

See how this background can pay off in meeting your own tower requirements. For details, send for Folder 2509 and tell us your needs. We'll gladly give you our recommendations and a quotation.

Transmission Towers—Steel Transmission towers, custom-built for each installation . . . multi-circuit and other special structures . . . and antenna towers, guyed and self-supporting types for AM • FM • microwave • communications • radar • parabolic antennas

BLAW-KNOX

BLAW-KNOX COMPANY
Equipment Division
Pittsburgh 38, Pennsylvania



Steel Mill and Foundry "hot spots" provide one of industry's worst torture chambers for wire and cable. Heat, overloads and corrosive fumes combine to kill ordinary cable quickly.

Don't take a chance on ordinary cable for troublesome "hot spot" applications. *Specify and use Rockbestos A.V.C.*

This superior AVA cable, with asbestos, varnished cambric insulation, takes temperatures up to 230°F, assuring continuous operation in hot spot applications, provides greater current carrying capacity for increased and new loads.

When you *specify and buy Rockbestos A.V.C.*, you reduce your electrical maintenance and construction costs . . . you get years more dependable service.

Write now for the new Rockbestos RSS-88 to help you *specify and buy Rockbestos A.V.C.*

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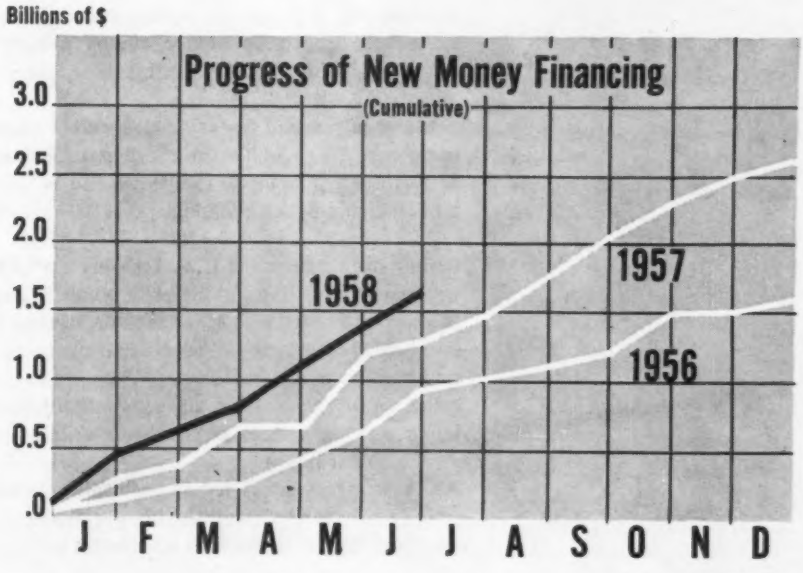
THE SUPERIOR A.V.A. CABLE

Report on
Utility Financing



Source: Irving Trust Co.

Big Float Stiffens Bond Yields

A record first half for electric utility new-money financing closed with a rush as $309 million in offerings hit the market in the month of June. The flood of June offerings carried total new-money financing by the electric companies to a record $1.54 billion for the six-month period—more than $300 million ahead of the first half of '57, and topping the totals for each of the full years 1955 and 1956.

But the half year wound up in unsettled fashion, with over $100 million in good issues clogging dealers' shelves, and bond yields stiffening. As the second half got underway, there was some disagreement among the men who know the bond market best as to where to pin responsibility for the hitch in yields—and even more disagreement as to where the bond market is likely to head.

To get a first-hand appraisal of financing conditions, EW interviewed analysts from a half dozen New York investment houses, used their comments and three months of additional experience with the '58 bond market to update the forecast of yields made in the April 14 Management Newsletter. In the opinion of these experts, the forces acting on the bond market are very close to balance. While yields could move a few basis points in either direction, it appears now that the end of the year will find them very close to their present levels.

Many forces act on the bond market. As an example, look at the combination of pressures that caused yields to turn up last month:

More favorable business conditions renewed the fear of inflation. Throughout last fall and winter, the economy's slide made common stocks unattractive to investors, who steered more of their money into senior securities. By June, however, some of the business statistics had begun to take a turn for the better; and bullish investor sentiment had carried the Dow-Jones industrial stock average to a new high for the year.

Investors were unsure of the Federal Reserve Board's policy. Last fall, when the Federal Reserve Board reversed its tight money policy, it flashed a signal insuring investors of falling interest rates and rising bond prices as long as the economy continued to decline. By June, however, there were rumors that the Fed was satisfied that the business slump was under control, and was getting ready to square off against inflation again by tightening up the money supply. This restrained the demand for bonds selling at a premium.

A heavy calendar of financing clogged the market. Not only did electric utilities bring over $300 million in offerings to market, but gas companies added over $100 million, municipals ran heavy, and U.S. Steel announced one issue for $300 million would be forthcoming.

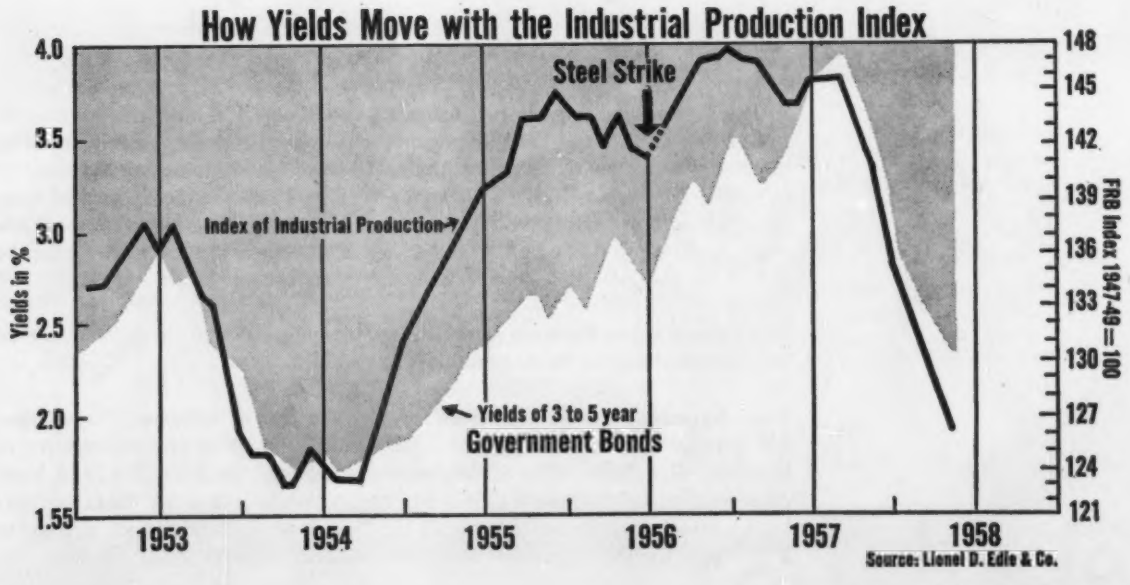
On top of this came the U. S. Treasury's $9.5 billion June refunding. The treasury issued $1 billion in long-term bonds, which compete directly for funds with the corporate market. Most of the rest went in 2⅝% short-term bonds, which also helped take some of the shine off the market. An excessive speculative position built up in the treasuries. When prices wavered in June, many buyers were called on for margin, and ultimately the Federal Reserve Board had to go in and buy bonds and bills in an effort to stabilize the market.

All these forces interacted to push utility bond yields up. Already the strength of each has changed, and the big question is: Where will their vector sum push the bond market in the next six months?

The second half will probably be lighter in utility issues than the first, which should weaken the upward push on yields. Irving Trust Co estimates that about 60% of the electric utilities 1958 financing has already been completed, and places the probable second-half total around $1.06 billion. July and August calendars are still relatively light—each under $150 million as EW goes to press.

It looks as though competitive municipal bonds will continue to run heavy for the rest of the year, but the total volume of corporate and municipal issues probably won't reach first-half totals.

Looking ahead for the rest of the year, financing men said bond market movements depend on two unknowns: Business conditions and the U. S. Government.



If business conditions show a marked improvement in the fall, there will be a tendency for the large institutional investors to increase their holdings of common stocks and reduce their holdings of bonds—forcing bond prices downward and yields up. If this improvement fails to materialize, bonds will gain in favor and there will be downward pressure on yields.

An historical example of the relationship of yields and the business curve was cited recently in a bond analysis by Lionel D. Edie & Co. The chart (p 104) shows how closely they have moved together in the past. Edie's analysis pointed out that the two curves were not correlated, but that a continuation of past trends would suggest that a pickup in the seasonally-adjusted industrial production index might well be accompanied by an increase in yield.

The Federal Reserve Board will also take its cue from the business curve. A spokesman for a large investment advisory service put it this way: "The June increase in bond yields can be attributed largely to interpretation of several government actions. Based on the recent improvement in business statistics, investors thought the Fed was getting ready to reverse its easy money policy—and that stiffened up yields. We don't think the Fed is reversing. We think the present easy money policy should continue for some months to come. Business is not yet so good that we can expect yields to rise. At the same time, they are not likely to drop much in the next few months either. The schedule of offerings is too heavy.

"In August the Treasury will finance some $16 billion in refunding. Suppose they put part of it in long-term bonds: That would siphon that much money away from the corporate market and restrain its advance," the advisory service said.

The comment of a spokesman for an important investment underwriter was echoed by several analysts: "If you can tell me what the U. S. Government is going to do, I'll make a lot of money."

When the Treasury enters the scene again in August, it seems likely that part of its refunding program will consist of long-term bonds. But how much will be long-term is a big question mark, and will probably remain up in the air until shortly before the Treasury comes to market. Before the end of the year, the Government will have close to $50 billion to raise—partly in refunding and partly to make up for the red ink in the federal budget.

So the Federal Reserve Board has two reasons to keep money easy: First, to stimulate recovery from the recession; and second, to enable the Treasury to carry out a heavy program of deficit financing at reasonable money cost.

A likely result of the concerted actions of the Treasury and the Fed was expressed by an analyst of a large investment firm: "I don't think there's any big change coming one way or the other. The Fed will stick with easy money. At the same time, the Treasury wants to stretch out its debt without upsetting the market. They won't glut the market with long-term securities which would drive yields way up; but every time the bond market sticks its head up, there will be more financing to be done, and that will keep yields from going much lower. If business starts to boom in the fall, the Fed will let interest rates rise; if the economy slips, the Fed will prime the pump. From now until the end of the year, we probably won't see anything but temporary gyrations."

And an economist put it this way: "The Fed will do just enough to insure the Treasury's ability to finance, and no more. The Fed's actions in June put people on notice that the Board is not going to just let bond yields drop away to zero. They wanted to stop speculation, and that desire will continue. As for the Treasury, they sold $1 billion in long-term bonds in June on a tight market. It's

logical that they might sell $2-3 billion in long-term stuff on a better market. I think yields will come down, but the Treasury will keep them from dropping as much as they otherwise would."

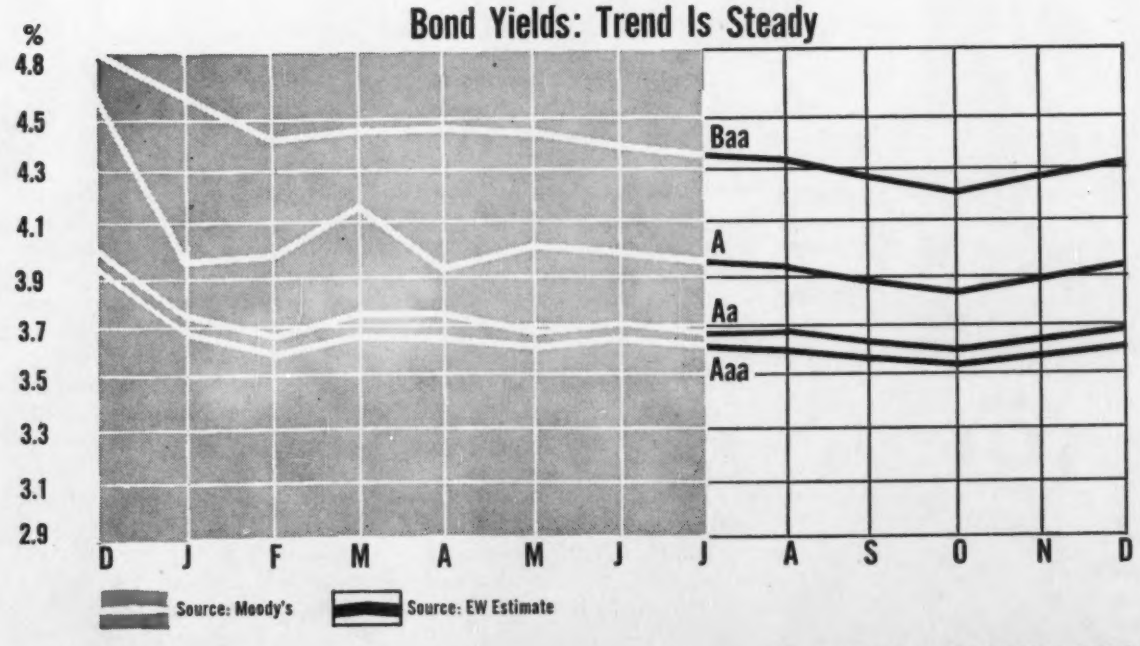
Still another factor is due to enter the scene in the fall. The large number of requests for Veterans Administration appraisals and Federal Housing Administration applications lends credence to the belief that private housing has already come out of its private recession; and as housing picks up, corporate bonds will face more and more competition from mortgages, which absorb funds from the same sources. Housing starts in May, for example, rose above the 1-million rate for the first time this year and show signs of continuing upward because of easier credit terms and legislative changes.

Calling the shots in the bond market entails guessing many other factors. It is necessary to predict the course of business and the intentions of the Federal Reserve Board and the Treasury, to begin with. Without a crystal ball, these basic predictions are a big order. However, assuming that the Fed will stick with a moderately easy money policy, that the Treasury will carry out its gigantic financing job guided by the policies that it has followed in the recent past, and that the recession will bounce along at near its present level for the rest of the summer with a slight upturn in the fall, here is a forecast of utility bond yields for the next six months.

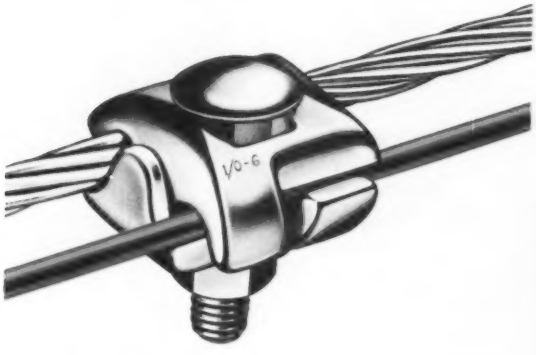
A lighter corporate financing calendar will probably allow undigested issues to move off dealers' shelves at about the present yield levels, and the next few months will likely see utility bond yields drifting slightly lower. The Treasury's financing will exert an upward pressure which will be reinforced, in the fall, by a mild upturn in business and an increase in housing mortgages.

There will be no big moves in yields this year, and December should see yields around present levels.

The longer term depends on business. If capital expenditures begin to pick up next year, yields will be forced upward, but it is unlikely that capital expenditures will rise appreciably before next spring at the earliest.



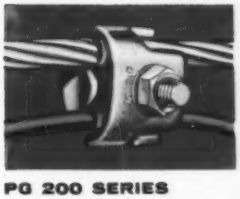
Users know they can install Chance Clamps and Connectors with complete confidence



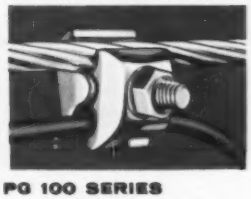
* Parallel Groove Clamps

Chance Parallel Groove Clamps are designed for low cost, easy to install, efficient power line connections. Heat-treated aluminum alloy body has high resiliency to keep connections tight under all loads and temperature conditions. Available in two types: "AA," uncoated aluminum body . . . and "AGP," with a heavy coating of Chance FORTIFIED Cadmium that resists electrolysis and corrosion in any bimetal connection.

YOUR CHOICE OF TWO DESIGNS



PG 200 SERIES



PG 100 SERIES

PG 200 Series Clamps have fingers that interlock around the main line and tap line. PG 100 Series Clamps have a wide jaw for the main line—interlocking fingers for the tap line. Both clamps contact ALL outside strands of ALL recommended conductor sizes. Chance Parallel Groove Clamps are also available in 2 and 3 bolt types for heavy service connections.

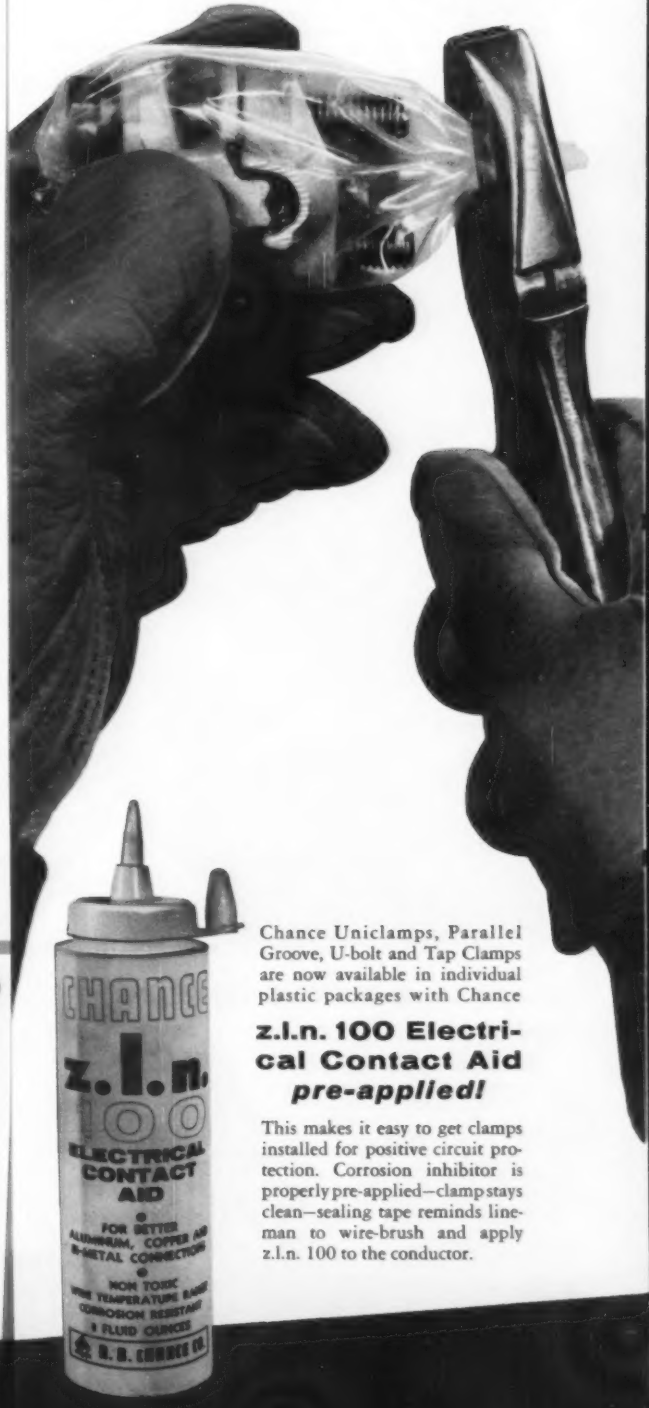
* CHANCE *PC* CLAMPS

Chance "Protected Connection" Hot Line Clamps are counter-balanced, light in weight, and have extra wide jaws for *conductor protection* . . . shielded high-strength spring for *contact protection* against thermal contraction and expansion . . . have threads enclosed in a chamber of lubricant, out of the arc zone, for *thread protection* . . . and are available individually packaged for extra circuit protection.

You can spot it by the RED EYE SCREW

Use AGP with heavy fortified cadmium coating for bimetal connections . . .

PACKAGED FOR CIRCUIT PROTECTION!



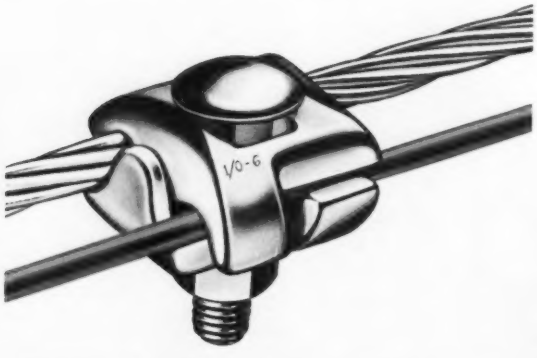
Chance Uniclamps, Parallel Groove, U-bolt and Tap Clamps are now available in individual plastic packages with Chance

z.l.n. 100 Electrical Contact Aid *pre-applied!*

This makes it easy to get clamps installed for positive circuit protection. Corrosion inhibitor is properly pre-applied—clamp stays clean—sealing tape reminds lineman to wire-brush and apply z.l.n. 100 to the conductor.

Users know they can install Chance Clamps and Connectors with complete confidence

because Chance
into every detail t



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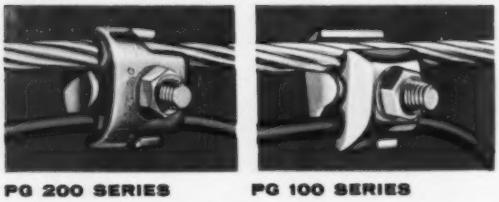

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You can spot it by the RED EYE SCREW

Use AGP with heavy fortified cadmium coating for bimetal connections . . .

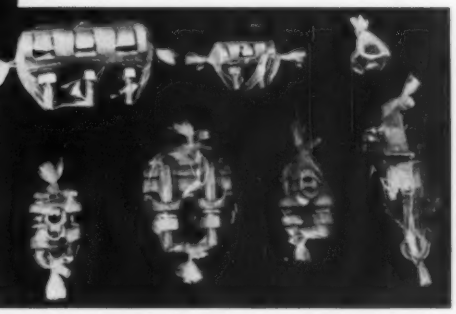
* UNICLAMP

The "one-piece" Uniclamp is popular with engineers who appreciate its high thermal efficiency, and with linemen because it can be installed without taking it apart. Available with aluminum, AGP (General Purpose) or copper bodies. For transmission or heavy duty distribution connections. Uniclamps can be applied with hot line tools.

GENERAL O

ance puts engineering skill
etail to protect your circuit

D. C. HUBBARD, Chief Engineer, Chance Conductor Specialties, says: "In choosing clamps and connectors, remember, that they can protect—or damage—the most important part of your circuit . . . the conductor. That's why Chance puts so much engineering into every tiny detail of clamp and connector design—to *protect your conductor.*"



nce Uniclamps, U-Bolt Clamps, Parallel Groove Clamps
2 or 3 bolt) and even Chance "Hot Tap" Clamps are
lable in individual packages with z.l.n. 100 pre-applied.

LAMPS

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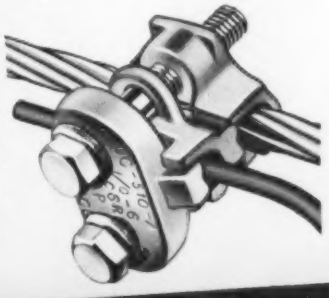


* U-BOLT CONNECTORS

Use these to make tight, low-resistance transmission and important heavy duty distribution connections. Aluminum bodied, in 1 and 2 bolt types for aluminum or ACSR connections. Designed to prevent "bird-caging" under surge conditions.

A · B · CHANCE COMPANY

ERAL OFFICES: CENTRALIA, MO. (A. B. Chance Company of Canada, Ltd., Toronto)

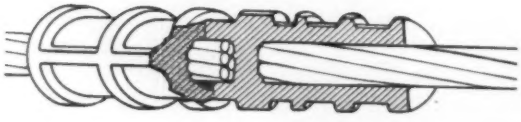
There's always a CHANCE for a better connection

SERVICE ENTRANCE COMPRESSION SLEEVES

Chance Service Entrance Sleeves are made in wide range of sizes to connect #10 Str. AWG through 1/0 ACSR conductors. They can be applied with any standard compression tool.

Color Coded and Plainly Marked

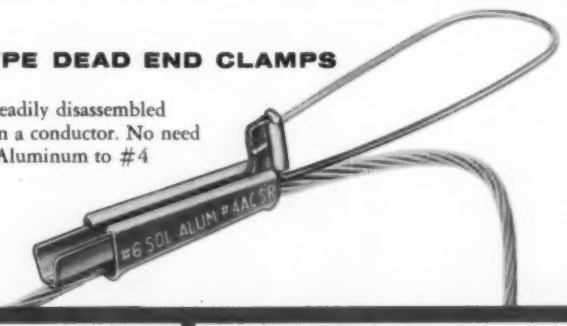
You have quick identification of conductor sizes for each sleeve with easy-to-read, color coded tapes on both ends of the sleeves and the same color coding on the box.



Metal wall in center of sleeve separates conductors—improves bimetal connections. Sleeves are filled with z.l.n. 100 Electrical Contact Aid for best conductivity plus corrosion resistance.

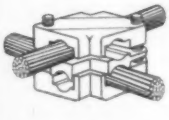
NEW...SERVICE ENTRANCE WEDGE-TYPE DEAD END CLAMPS

Use these clamps for better service drop construction. Can be readily disassembled and assembled, without tools, for easy fastening to any point on a conductor. No need to thread conductor through the clamp. Range from #6 Solid Aluminum to #4 ACSR 6/1 or 7/1.



SPLIT-BOLT CONNECTORS

Give high conductivity plus strength. These Chance copper connectors have the same characteristics as the conductor they connect. You get an efficient cool operating joint that stays tight because both clamp and connector have the same coefficient of expansion. Sizes to fit #10 .o 1/0 Str. conductor.



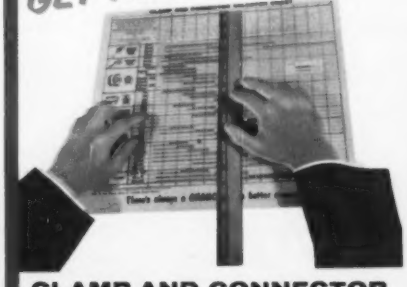
MULTI-TAPS

For cross T, end to end, and parallel connections. Three sizes meet all requirements.

GROUNDING TERMINALS

High strength copper alloy connectors designed for grounding transformer tanks.

GET THIS!



CLAMP AND CONNECTOR CHART It helps you pick quickly—by catalog number—the Chance Clamps or Connectors for any specific job. Write for your FREE chart today.

A · B · CHANCE COMPANY GENERAL OFFICES: CENTRALIA, MO.
(A. B. Chance Company of Canada, Ltd., Toronto)

CC5

Engineer Designs Economical Grain Dryer

A relatively inexpensive electric grain dryer adapted to small farms has been developed by a TVA agricultural engineer, J. L. Montague, Jr. Essential features of the drying unit are grain bins, air ducts, a fan combined with small electric heaters and a humidistat.

The unit forces air up through grain stored in wooden or metal bins, thus carrying off moisture. When outside air becomes humid, a heating unit cuts on and the hot air continues to dry the grain. The unit, excluding the storage bins costs approximately $500.

"Heretofore, available equipment has been designed for quick drying," Montague said. "The dryers were tailored to commercial rather than average farm needs and required three-phase service. But with this new small unit, single phase power supply may be used to dry grain at an economical rate."

In his studies Montague found that satisfactory drying conditions could be based on 50% relative humidity, and that a maximum of 18 F temperature rise will bring any air to an RH of 50% or below.

Using a humidistat as the control, the heating element cuts in when the relative humidity hits a predetermined value, usually 50%. The remainder of the time, unheated air is forced through the grain by a high-speed electric fan. By using heated air during periods of high humidity, small equipment can do the same job a large outfit would do with unheated air.

DRYER CONTROLS are mounted on stand above fan. Heating units are used when incoming air is excessively humid

'Give Better Electrically' Is '58 Christmas Ad Theme

Calling on the nation's consumers to "Give Better Electrically", the electric housewares industry is planning a fall Christmas promotion. The program will unite for the first time the Christmas merchandising efforts of manufacturers, retailers and utilities on a nationally coordinated basis, and is spearheaded by a November ad in Saturday Evepost. The ad will consist of a four-color center spread with 10 full-color pages bound into the lower half, dutch-door fashion. Each of the half-pages will be divided into fours, illustrating various products of the participating manufacturers.

This is reportedly the first time competitive manufacturers in the electrical industry have participated in a single ad and the largest single ad ever placed in a consumer medium by one advertiser. The ad will be reprinted in booklet form, to be used by retailers as a giveaway.

Live Better Electrically will prepare the magazine ad as well as a completed merchandising and publicity package, and will provide liaison between manufacturers, utilities and associations.

Sees 350,000 Heat Pumps

More than 350,000 unit heat pump installations are waiting to be filled "within the immediate future" by the 30 or more manufacturers now in the business, according to Paul F. O'Neill of General Electric's Weathertron Department.

At a meeting sponsored by Duquesne Light Co, O'Neill went on to trace the growth of the heat pump industry from one a few years ago with only five companies manufacturing to one today with a 600% increase in that number. Product lines, too, have exploded. O'Neill cited GE, as having only one line then and more than a dozen now.

Sylvania Offers Salesmen Lamp Course

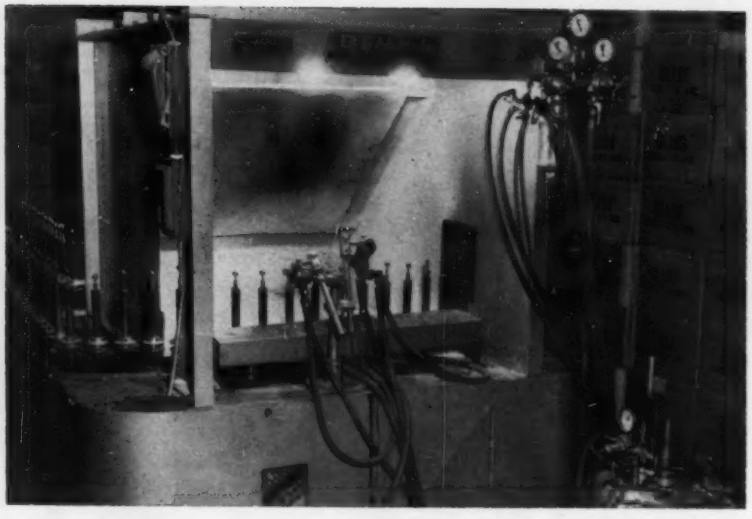
An electric lamp home study course has been developed by Sylvania Lighting Products to provide basic instructional material for distributor salesmen and countermen, electrical contractors. The eight-lesson course covers the principles, characteristics and applications of the three main types of lamps—incandescent, fluorescent and mercury vapor. It also provides information for utility sales personnel.

All texts and study materials are supplied with the lessons, and tests are graded and evaluated by experts. A certificate is awarded when the course is completed.

Registration may be made by writing: D. C. Lash, Jr, manager sales training, Sylvania Lighting Products, 60 Boston St, Salem, Mass. Cost: $10.00.

(*More Selling on page* 112)

Using only one operator . . .



. . . and automated spray booth . . .

Modern Painting Line Produces Fewer Rejects

EDWARD H. PECHAN, JR, Industrial Power Engineer, West Penn Power Co, Latrobe, Pa.

A better product in less time, with fewer rejects and less labor—these are the results at Imperial Lighting, Latrobe, Pa., since it automated the spraying of threaded metal knobs used on lamps and ceiling fixture shades. Formerly, the knobs, called finials, were hand-dipped in lacquer. When they were dry, it was necessary to remove the lacquer which had filled the internal threads by a slow, manual process. Unreliable too, it often resulted in damage to the lacquered surface of the ball. This meant the job had to be re-done.

Today, one operator can handle the entire job. Sitting behind the spray booth, she places the unpainted finials on spearlike posts on an endless conveyor with her left hand. As the finials reach the control point in the spray booth, they activate the sprayer and are automatically lacquered. The knobs are then air-dried as they return to the operator who removes them with her right hand. The tedious, unreliable job of removing unwanted lacquer from the internal screw has been eliminated. Each finial is evenly lacquered, ready to use sooner.

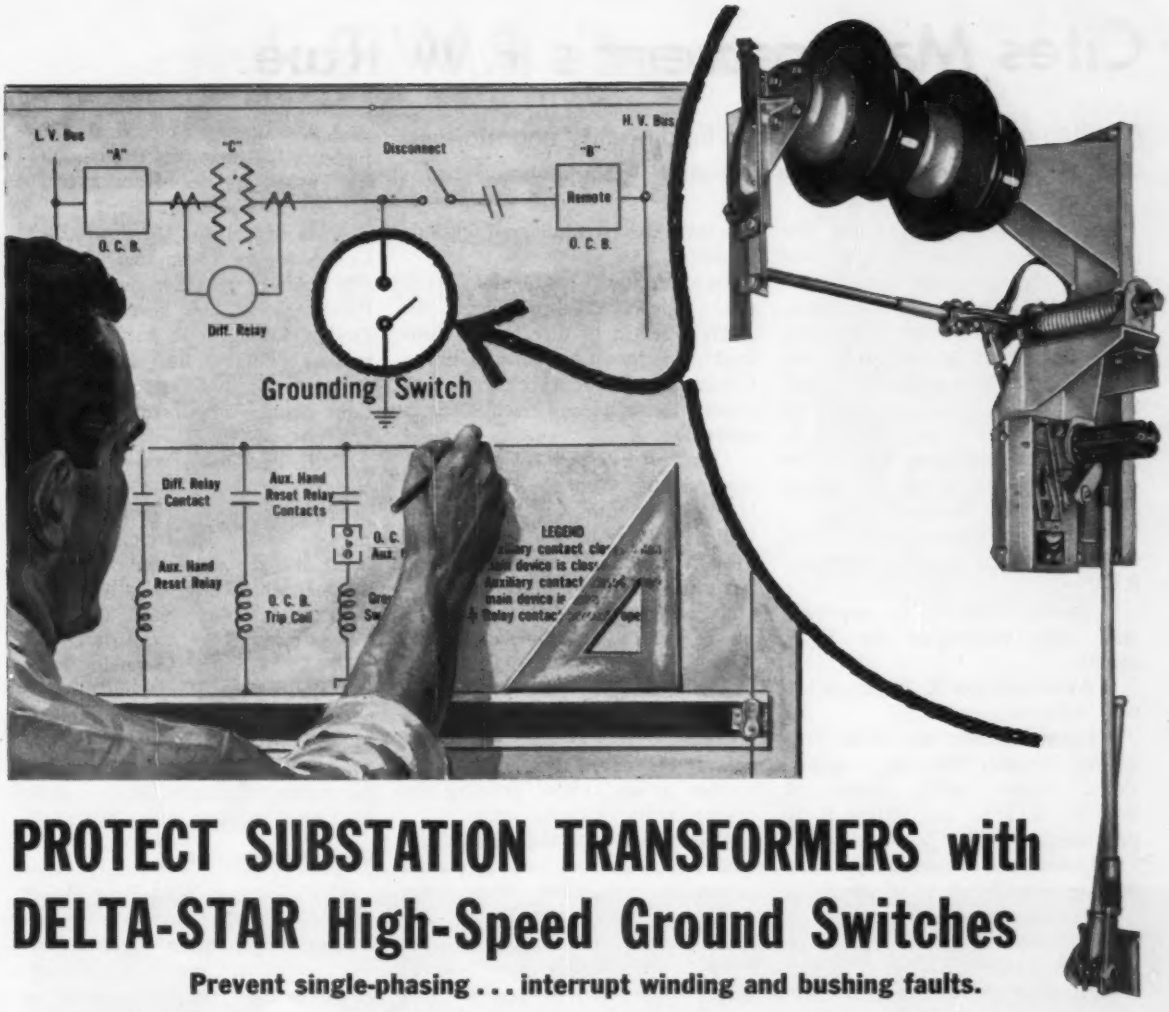
Photo Scanner Lessens Fabric Losses

A. B. MORGAN, Industrial Sales Engineer Connecticut Light & Power Co, New Milford, Conn.

Two photoelectric scanners that automatically detect broken threads in knitted fabrics have caused a big reduction in the amount of unsatisfactory material produced at Litchfield Trico Fabrics, Inc, in Bantam, Conn. Coupled with the latest type of control equipment, they stop the high speed machines, even at top speed, when a maximum of two inches of cloth has been produced.

The scanners are mounted eight ft above the knitting machines, entirely out of the operators' way. The inspecting eye swings back and forth from a stationary position. When a break occurs, it causes a large change in the amount of light reflected from the knitted material. The amplified impulse from the scanner actuates a relay which stops the machine immediately.

The completely automatic scanning is the result of a successful program of experimentation carried out at Litchfield. The highly modern plant is operated on a continuous, 24-hr a day schedule.



PROTECT SUBSTATION TRANSFORMERS with DELTA-STAR High-Speed Ground Switches

Prevent single-phasing . . . interrupt winding and bushing faults.

When a substation transformer develops a winding or bushing fault, cut it out of the system *fast* to prevent extensive damage. You *can*, without elaborate and costly differential-relay-and-breaker systems, when you install Delta-Star High-Speed Ground Switches.

These automatic switches operate only under transformer fault, and carry fault current without welding closed. Lightweight reinforced switch blades close rapidly with minimum spring force, preventing excessive impact at the contact end. Direct coupling of switch blade to spring mechanism insures positive operation even under severe ice conditions.

Delta-Star High-Speed Ground Switches of multi-pole types protect transformers against single-phase operation in the event of a fuse opening a line. They are also applicable in systems protected with Petersen coils.

Made in voltage ratings to 161kv, with closing speeds of 12-30 cycles. Short-time current rating up to 20,000 amperes for five seconds (far longer than they can be expected to be in the circuit). Available to fit any outdoor substation layout; upright, inverted, or horizontal insulators.

ULTRA-HIGH-SPEED FILM AVAILABLE. Ask your nearest Delta-Star representative to arrange for your group to see the new film which shows Delta-Star Automatic High-Speed Ground Switches in action under load. Or write *Dept. 10B, Delta-Star Electric Division, H. K. Porter Company, Inc., 2437 Fulton Street, Chicago 12, Illinois. District offices in principal cities.*

H. K. PORTER COMPANY, INC.

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Cites Management's R/W Role

Moulton urges ground rules to aid field agents' negotiations; and, ARWA board authorizes all-utility committee

Utility management can ease the job of right-of-way people materially by affording more lead time for acquisition through better planning. With R/W problems becoming more disturbing, ground rules for management are in order, the Utility Section of the American Right of Way Association, was told by J. S. Moulton, vice president Pacific Gas & Electric Co at San Francisco, May 26-27. He proposed:

- Better cooperation among utilities seeking adjacent or overlapping R/W.
- Specific training in appraisal and sales techniques for R/W agents.
- Assurance that R/W people are well informed.
- Formal public education programs, through planning commissions, service clubs, municipal boards, etc., to air utility R/W problems.
- Utmost use of personal contacts developed by local utility people.
- Adherence to fair-price principles in negotiations.

Recent California court decisions, which admit speculation as a valuation factor, add another reason to shy away from condemnation, said Moulton.

In a step toward recognizing utilities' right-of-way problems, the ARWA board of directors authorized formation of a separate Utilities Committee, including electric, gas, water, telephone and sewage representatives.

One-fourth of new highway mileage, resulting from the Federal-Aid Highway Program, will require some utility relocation, and more than 300,000 miles of 22 kv and up overhead must be moved, said S. Houston, Chesapeake and Potomac Telephone Co, and newly-elected ARWA chairman.

The affected agencies must adopt a formal planning and coordinating procedure, Houston said, to prevent delays. He called for adoption of written ground rules, defining the responsibilities of each party.

Don't depreciate the utilities' liaison responsibilities and blame all confusion and delay on highway authorities, said R. H. Taylor, Detroit Edison Co and outgoing ARWA chairman. Utilities should review their own notification and coordination procedures severely, he said. A sampling of electrical utility-highway liaison experience was cited by Taylor, quoting from a recent survey:

T. B. McAuliffe, Duquesne Light Co: A formal committee of utility and highway people in metropolitan Pittsburgh has long been operating. Design savings due to long-range mutual planning and construction savings under optimum work conditions due to coordinated schedules are claimed.

K. E. Personius, New York State Electric & Gas Co: Contacts between utility district offices and state public works departments, developed over 25 years, have provided utilities with confidentially treated advance highway plans and permitted early R/W acquisition.

W. L. Deckman, Cleveland Electric Illuminating Co: Highway department red tape often slows release of utility-held mortgages on new road R/W. Utility and highway departments frequently fail to coordinate when working with contractors.

Urges Cooperation

C. H. Adams, West Penn Power Co: Although utility supervisory levels can successfully advise municipal authorities on R/W matters, attention must be paid to working levels where difficulties in interpretation often appear.

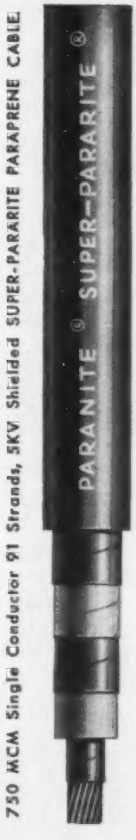
H. A. McDaniel, Northern States Power Co: A successful means of obtaining advance highway planning data is to assign a utility man having highway liaison as sole responsibility. Northern State's man spends as much time in a highway office as in his own.

Utilities yet are uncertain on federal Bureau of Public Road relocation reimbursement policies, said A. W. Althouse, Southern California Edison Co. Will costs charged to obtaining detailed authorizations for reimbursable relocations from the Bureau engineers be commensurate with gains, or will the requisite procedures create untenable delays, Althouse asked.

As example, utilities apparently are required to record with the Bureau a flat evaluation before completing negotiations for the new

(*Continued on page* 116)

R. H. TAYLOR, Detroit Edison (left) is outgoing ARWA chairman. He is shown with Pacific G&E's J. S. Moulton and C. C. Coates, and with S. Houston, Chesapeake & Potomac Telephone Co. Houston succeeds Taylor in chairmanship



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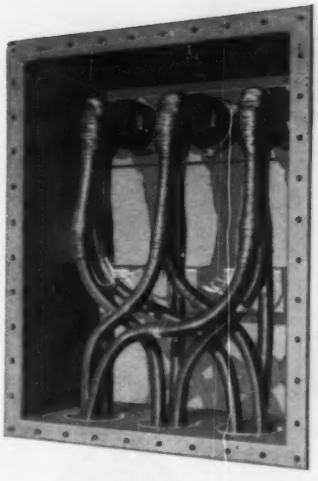

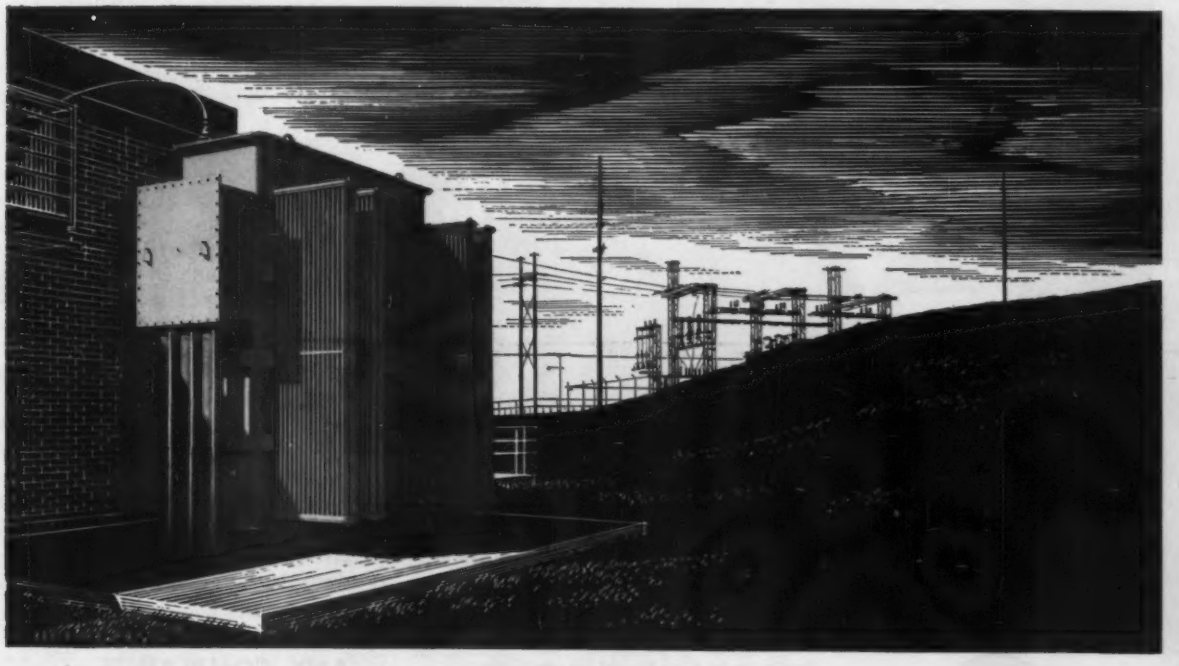

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Cites Management's R/W Role

(*Continued from page* 114)

R/W, said Althouse. He called for modification of this procedure to permit a working range for the negotiator.

PG&E's land economic studies have shown repeatedly that easements do not adversely affect property values. In some cases, encumbered properties actually sold higher later because easements provided space left clear of buildings, said C. W. Coates.

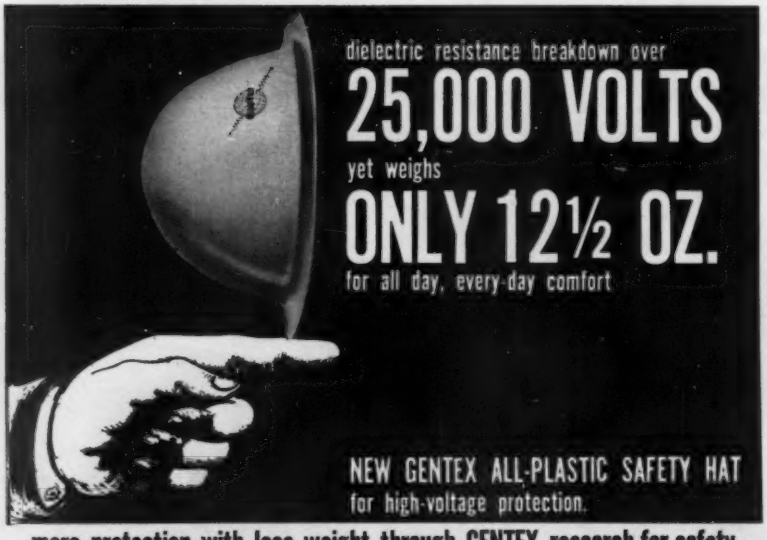
The land economic study establishes historical reaction of property market values to easement encumbrances by obtaining subsequent sales data. Defining these studies as "an extension of the appraisal process," Coates marked them as a powerful tool aiding in holding R/W acquisition costs to reasonable levels.

Accumulation of land economic study data and dissemination through R/W associations would improve R/W public relations, Coates declared in conclusion.

Development of broad knowledge is the R/W agent's most powerful tool, said R. M. Lovell, New England Power Service Co. He must recognize and understand interests of three diverse groups: utility stockholders, general residents of an area, and the actual property owners. Thus he must be well versed in their immediate problems and in varied collateral background.

Don't rush your R/W negotiator, urged McDaniel. Most citizens are chary of signing legal documents, and the agent must pick his time. A good R/W agent should not hesitate to tell a property owner the amount paid his neighbor, said McDaniel.

Good relations with local property owners have been fostered for many years by Northern States through strict adherence to a price schedule and rejection of horse-trading, he said.



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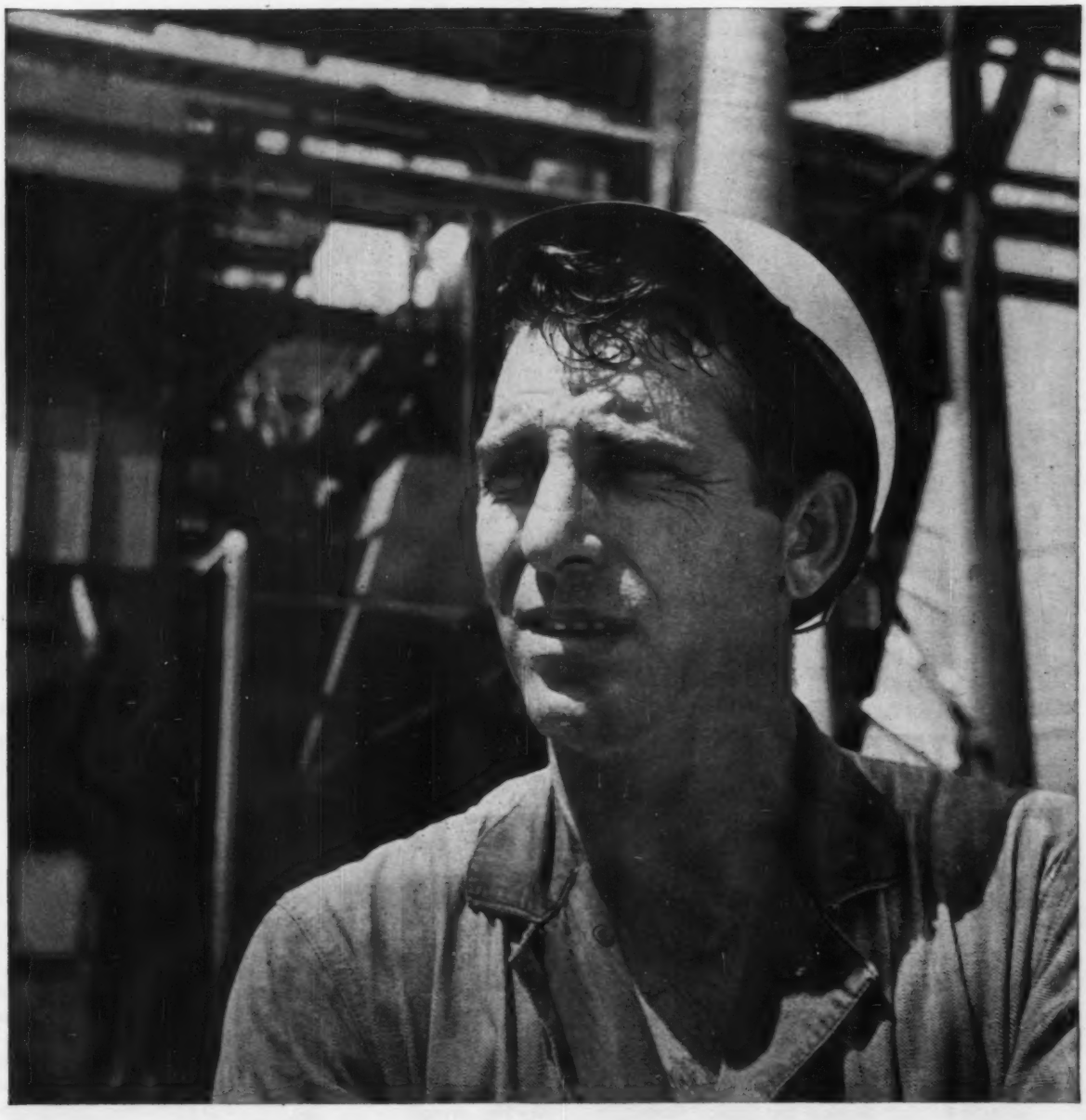
Says Higher Distribution Could Lose Some Load

A change to a higher secondary voltage by utilities will encourage the use of fossil fuels by their customers, H. H. Watson, General Electric Co., told the American Institute of Electrical Engineers' Appliance Technical Conference in Chicago May 26. He discussed the grounding of appliances and outlets in the home, noting that better insulation would be a desirable solution to shock hazard.

Watson said that within 10 years grounds will be required on all outlets for portable appliances, although only some appliances listed by the Underwriters' Laboratories will have means for grounding. The use of nonmetallic outer surfaces and improved insulation, he said, will reduce the need for grounding them.

ANY COMPLAINTS . . .

about postal service? Maybe you aren't using complete addresses, including zone number.



HOW YOUR PLANT CAN PROFIT FROM THIS MAN'S SKILL. Dowell engineers are experts in the use of chemical solvents to remove scale and sludge—those profit-robbing deposits that cut the capacity of your process systems, tanks, piping. Using the Dowell method of chemical cleaning you get more throughput, less down time—to make possible greater overall plant efficiency.

Here's how one corporation employed the skill of the Dowell engineer and his group: Following construction and before the plant was put on stream, the company called in Dowell to remove mill scale.

Total cost of this mill scaling service was $5000. Once in production the plant did not have a single major shut-down for maintenance due to mill scale. Management of the plant credits Dowell service with helping them net an operating profit of somewhere between 10 and 20 times the cost of the chemical cleaning. That amounted to between $50,000 and $100,000 the first year.

With Dowell service you get 15 years experience in chemical cleaning, full lines of equipment and chemicals—plus an engineered job—performed by trained crews.

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Where overhead distribution lines must cover long spans, or in areas where high velocity winds and adverse weather impose a severe strain on power poles, dependable guying is a must.

To provide safe installation and long, trouble-free service life, ground crews prefer CF&I Galvanized Steel Strand. It is made of steel with exactly the right chemical and physical properties to assure high strength and easy workability. The wire is carefully drawn, stranded, cleaned and galvanized with a tightly-bonded coat of pure zinc to produce a corrosion-resistant finish that won't flake, even when severely bent.

CF&I Galvanized Steel Strand meets or exceeds ASTM Specification A-122 or A-363, and is made in a seven- or three-wire construction to meet your specifications. Your nearby CF&I representative or local electrical distributor can give you complete details. Call him today.

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5904-A

J. T. KIMBALL

Sees Socialization of Utilities Losing Appeal

Kimball tells PCEA politicians must yet be convinced that there are no votes in promoting more federal power

Politician, lady customer and investor—three of the utilities' most influential "publics"—took the rostrum of the Pacific Coast Electrical Association's annual convention at Coronado, Calif., May 14-16, to serve direct-action public relations advice to utility executives. The people have "turned the corner" against socialization of electric utilities, but this fact hasn't impressed the politicians: utilities must find means of convincing politicians there are no more votes in federal power, said J. T. Kimball, vice president, Idaho Power Co.

A grass-roots political approach is mandatory, counselled J. E. Reich, executive vice president, Indiana State Chamber of Commerce, who identified himself as "a politician and paid lobbyist." To establish firm political support, you must win over the precinct committeeman, who represents the voter in the writing of platforms, Reich said.

"I don't want to read big black ads about public power and private

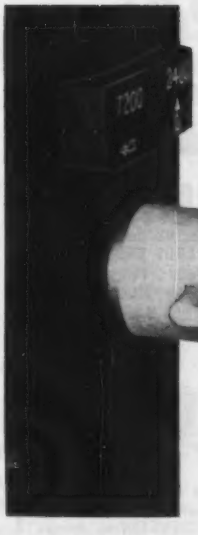
(*Continued on page* 120)

A TWIST OF THE WRIST CHANGES THE VOLTAGE...

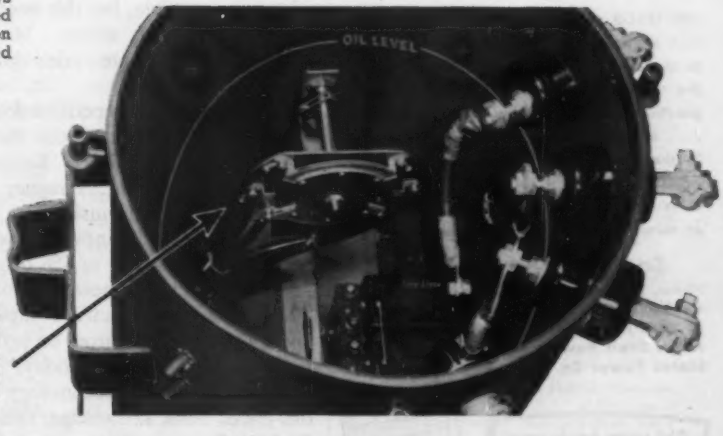
QUICKLY SAFELY ECONOMICALLY

To switch from 2400 to 7200 volt operation with Standard's external tap changer, all you do is unscrew the cap, turn it around and use it as the key to turn the switch. It's that easy...that safe...that economical. The plainly marked indicator shows you the job's been done right. You eliminate cover removal and reduce the danger of tank breathing and oil contamination. Your Standard Transformer representative has complete facts. Have him show you how this all-new externally-operated tap changer meets your needs.

For immediate prices and specifications write directly to Standard.



Voltages are unmistakably marked. Gasketed winged protective cap with machined threads unscrews easily. Slotted end is used to turn switch. Wings on cap indicate desired voltage.



Spring loaded switch, below oil level, assures positive positioning for the voltage selected. Impulse level of the switch exceeds that of the transformer.

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"WHEREVER THERE IS POWER"

Transformer Loss Compensator

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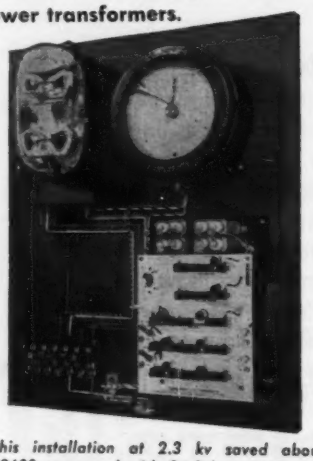
BECAUSE it provides an accurate means of measuring the energy and demands of high-voltage services at the low-voltage side of the power transformers.



This installation at 2.3 kv saved about $2600 compared with 34.5 kv metering; it saves about $5500 over metering at 69 kv.

THE TESCO compensator adds to the registration of the watthour meter an amount equal to the sum of the iron and copper losses of the transformer bank. It may be used with practically any type of watthour meter and . . . importantly . . . no changes are made in the meter itself, either structurally or in adjustments , . . It is produced in two and three element types for use with two-element or three-element meters on any type circuit.

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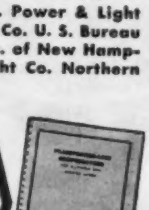

EASTERN SPECIALTY CO.

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PCEA Meets

(*Continued From Page* 118)

power and Sen X and Gov Y," said Mrs. Jean Rindlaub, Batton, Barton, Durstine & Osborn. "Mama" wants a little attention, a little build-up, a little smile, a little deference—she wants to feel cherished. Understand these wants, and act on them in advertising, in personal contacts and in letters, advised Mrs. Rindlaub.

Interest in growth rapidly is superseding the investment public's emphasis on firm, steady income of fixed-interest securities. Utilities must capitalize, in communications with the financial community, on anything reflecting growth, recommended H. H. Young, partner, Eastman Dillon, Union Securities & Co.

Physical plant per se "leaves security analysts cold," he noted. They're more impressed by your personnel development, employee morale, service attitude toward customers, civic participation, and aggressive load building programs.

Lack of utility growth means corporate and operating trouble, too, persisted J. W. McAfee, president, Union Electric Co and EEI president. Constant load level results in lack of outlet for depreciation accruals, and, with no modern plant additions, no relegation of obsolete facilities to standby status.

A "combination" utility is obligated to sell both services as completely as possible, but this need not reduce sales of either, McAfee stated. Let separate sales groups compete, he urged.

Anyhow, real competition for the customer's dollar isn't from the gas industry, said M. G. Kennedy, Ebasco Services, Inc. Tougher foes are the hundreds of businesses, such as the automobile industry, which frequently invest 5% to 8% of gross revenue in new-business promotion. Pre-war, he said, electric companies spent nearly 3% of gross on promotion, but only half that today.

Nuclear energy technology has out-paced basic knowledge, said Dr. F. de Hoffmann, vice president, General Dynamics Corp.

Engineering-construction firms should set a 10 to 15% cost reduction goal over the next five years for new generating capacity, as a contribution to their clients' programs to lower overall costs, said J. P. Yates, Bechtel Corp.

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CEDAR POLES • FIR CROSS ARMS

Pentachlorophenal Treated—protected against decay, moisture and insect damage, and give long service life. Thoroughly tested and approved by leading public utilities as standard construction.

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PORTABLE ELECTRIC POWER

WITH
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IDLING CONTROL
EXTENDS ENGINE LIFE
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WINCO MODEL 2058145 2D-1M 2500 watts, direct drive, 115 volts, 60 cycle A. C. Lightweight. Carrying Cradle optional

After starting, plant automatically idles, until load of 75 watts or more is applied. Automatic CONSERV-er brings engine to full power when tool is turned on, reduces engine to idling speed when tool is turned off—all automatically. Get all the facts on this Profit-Building Winco feature.

FULL LINE OF PORTABLE AND STAND-BY AC & DC PLANTS. 300 WATTS TO 10 KW
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SIOUX CITY, IOWA
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Neoprene-jacketed cables were removed from manhole after 9 years of service. Jackets were in excellent condition although sections of these cables had been submerged continuously.

In water for 9 years...lead-sheathed cable with neoprene jacket gives Philadelphia Electric Company "excellent performance"

Neoprene jacket offers cable lasting protection and often makes savings possible. A case in point: 975 feet of 69,000-volt cable installed in 1948 at Philadelphia Electric Company's Holmesburg substation.

The savings here were in laying the duct. Instead of the costly grading needed for drainage, the engineers specified three lengths of lead-sheathed cable jacketed with Du Pont neoprene to protect them against ground water in the duct.

This decision was fully justified recently when expansion of the substation required that the cables be removed. Inspection of the neoprene jackets showed no signs of deterioration – *even though sections of these cables had been totally immersed for nine years.* Also, sheath-to-ground resistances were 10 megohms per square foot at the time the cables were removed. This is excellent performance.

This is another example of neoprene's dependability. It is the preferred jacketing material for a great variety of wire and cable because of all resilient materials, only neoprene has balanced resistance to sunlight and weather, oils and chemicals, heat, flex cracking, abrasion and cutting, oxidation and aging.

It pays to be familiar with the properties of neoprene. We'll be glad to put you on the list for regular copies of the ELASTOMERS NOTEBOOK, detailing neoprene's performance in a wide range of industrial applications. Just mail the coupon below.

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NEES Subsidiaries Promote Walsh, Clarke

New England Electric System has announced the promotion of T. Joseph Walsh to vice president, Quincy Electric Co and Weymouth Light & Power Co, and the promotion of T. Dexter Clarke to vice president, Narragansett Electric Co.

Walsh began his utility career in 1918 when he went to work as an auditor for the former Gas & Electric Improvement Co, Boston.

In 1930 he became a traveling auditor for New England Power Service Co, and in 1941 was appointed treasury representative for the north central district.

The Quincy and Weymouth companies made him assistant treasurer and a director in 1944.

Clarke, new vice president of Narragansett Electric Co, attended Brown University and Yale University Law School. He was a practicing attorney in Providence, Rhode Island, for a number of years, and in 1941 joined Narragansett's legal department.

In 1946 at Narragansett Clarke was made secretary and counsel, and later was named to the same positions with the Mystic Power Co, also an NEES subsidiary.

T. J. WALSH

T. D. CLARKE

Chase Assumes Vp Position

The Montana Power Co has elevated Sam B. Chase to the position of senior vice president and counsel.

After serving with the Marines in WW I, Chase entered Harvard University, receiving his law degree in 1924. For a number of years following his graduation he practiced as an attorney in Great Falls.

He was named a director of the Montana Power Co in 1953, and the following year was made vice president and counsel by the utility.

Active in many companies associated with Montana Power Co, he is vp and counsel, Montana Gas Co, Western Gas Co and Glacier Gas Co.

Herr Advances to Vp Post

Central & South West Corp has elected Frederick J. Herr Jr as vice president.

Formerly associated with the public utility department of Lehman Brothers, New York investment banking firm, he left there in 1940 to join the Navy. His military service extended until 1945, when he was discharged as lieutenant commander, returning to Lehman Brothers.

In 1953 Herr left the investment firm to accept a position with Central & South West Corp where, for the past five years, he has been assistant to the president.

SECONDARY UNIT SUBSTATIONS

① **Incoming Section:** Terminal chambers; disconnecting and interrupter switches; roof bushing; metal-clad type HV/switchgear. ② **Transforming Section:** Askarel or oil-immersed type transformers; ventilated dry type transformers; sealed dry type transformers. All manufactured at I-T-E in Philadelphia. ③ **Outgoing Section:** The new K-Line of low voltage switchgear featuring manually charged or motor charged stored energy quick-make circuit breakers, and all with the closed door drawout feature.

I-T-E assumes all responsibility for your substation requirements

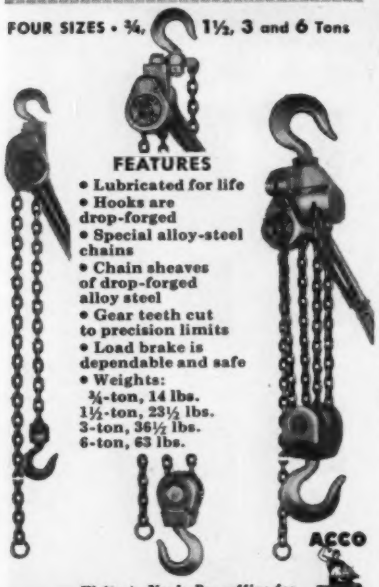
When you place an order for an I-T-E secondary unit substation, you can forget detailed planning, paperwork and the problems of coordinating delivery. I-T-E assumes complete responsibility. It engineers the unit to meet your requirements. It builds the transformers and switchgear. It assembles the complete unit under one roof, testing it to assure ease of installation and top performance. It ships the unit *as one package*, from one location, and ready to install.

Typical of the extra values found only in I-T-E secondary unit substations is the new quick-make K-Line of low voltage switchgear. A manually charged mechanism in each circuit breaker stores energy in the first 90% of pulldown handle travel, releases it in the last 10%. It also features racking to all positions—connected, test and disconnected—while doors are closed. Both features greatly increase operator safety and reduce maintenance problems. I-T-E secondary unit substations can be supplied for any application, indoor or outdoor, and in any standard rating. For details, contact the I-T-E sales office nearest you. Or write Switchgear Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Phila. 30, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ontario.

I-T-E CIRCUIT BREAKER COMPANY
PHILADELPHIA • PENNSYLVANIA

NEW WRIGHT
Type "C" Pull-A-Ways

FOUR SIZES • ¾, 1½, 3 and 6 Tons



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PERSONAL BRIEFS

Changes in the line department of Potomac Edison Co place **Marlin H. Thurmond** as assistant line superviser. **William E. Petry** has been selected to fill Thurmond's newly vacated position as superviser of the Hagerstown district.

Chairman of the board of Canadian General Electric Co, Ltd, **Ian F. McRae,** has been elected president of the Canadian Manufacturers Association, succeeding **Harold V. Lush.**

In three changes of assignment by Puget Sound Power & Light Co, **Emmet P. Kelly** becomes safety director; **George L. Artus** takes on additional duties as superintendent of the division of power supply; and **Joe T. Bradshaw** becomes new general claims agent. In another change, **Clifford G. Johns** was transferred to Bellevue as assistant to **Richard P. Mortell,** assistant operating manager.

Mississippi Power & Light Co announces the following organizational changes: **C. M. Brough** has been given added responsibility as assistant to the president. The present northwestern division is to be divided into two new divisions: The Greenville-Hollandale-Rolling Fork area becomes the NWN division under **Joe M. Hinds,** manager; and the Indianola-Belzoni-Greenwood rural area is to be known as the sunflower division, under **J. Stewart Frame,** manager. The western division will have **Joe H. Box** as its new manager, while **C. Lamar Stephenson** moves up to central division as assistant to division manager, and **John M. Craft** goes to the general office as operating assistant.

O. L. K. McKibben has been elected treasurer of West Penn Power Co, succeeding **E. S. Raymond. John E. Mueller** has been promoted to director of planning on the utility's executive staff, succeeding **Harry Restofski,** vice preisdent-planning, who will retire July 31.

New superintendent of operations for Duquesne Light Co's downtown district is **John P. Schmidt.**

A. J. Cooper, former New York and empire region maanger for Allis-Chalmers has retired after 49 years of company service.

James H. Foote, chief engineer and president of Commonwealth Associates Inc, long time researcher in high voltage transmission, has been awarded the honorary degree of doctor of science by Wayne State University.

James H. Crawford, vice president and general manager of General Electric Co's motor and generator division, has retired. **Oscar L. Dunn** will step in as the division's new general manager.

A new district, to be known as south central, has been formed by the AIEE with **C. P. Knost** as district vice president. The new district, AIEE's 13th, comes into being August 1.

Robert N. Wagner has been appointed chief electrical engineer by ALCOA.

Recently risen to manager of the newly formed nuclear energy and power plant section of the sales development department, Chemtron Corp, is **Frank Briggs.**

R. T. Cathey has been selected as Dallas district manager for Bailey Meter Co, succeeding **F. D. Krusemark,** resigned.

OBITUARY

George E. Fletcher, 53, president, Columbia Electric Manufacturing Co, died recently at his home in Atherton, Calif.

George M. Hardy, 83, retired vp, Worcester County Electric Co, nationally known electrical distribution engineer, died recently at Brattleboro, Vt.

E. Fay Pearce, 67, retired Georgia Power Co sales executive, died recently at his Atlanta home.

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One (1) Marley Cooling Tower, induced draft, #7-30 Double Flow, 14 cell 63 ft x 211 ft x 25 ft high, with seven (7) three bladed adjustable pitch stainless steel clad fans, seven 60 hp, 1800 rpm, 440 volt motors and accessories. Tower designed for 42,200 gpm, 316 million Btu/hr duty, 105 F water to tower, 90 F water from tower, 76 F wet bulb. Installed December 1947.

One (1) ITE Unit Substation assembly, outdoor type, 400 kva, 2400-480 volt oil cooled transformer; switchgear four frame mounting with seven type KA breakers. Installed late 1947.

One (1) Marley Cooling Tower, induced draft, #9-2431 Double Flow, 9 cell, 63 ft x 217 ft x 39 ft high, with nine (9) aluminum alloy fans, nine 60 hp, 1800 rpm, 440 volt motors, and accessories. Tower designed for 61,300 gpm, 353,500,000 Btu/hr, 108 F water to tower, 90 F water from tower, 76 F wet bulb. Installed October 1950.

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Wanted—University graduate Engineer with at least five years experience operation steam electric generating station for responsible position in Maracaibo, Venezuela. Preference will be given Spanish speaking applicant. Salary dependent on qualifications. P-8320, Electrical World.

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Electrical Engineer—Thoroughly experienced in electric power field—high and low voltages—excellent references, capable, young, mentally alert and flexible. PW-8360, Electrical World.

Readers Forum

Gremlins Creep In

To the Editor:

Through the many years of reading Electrical World I have failed to find any discrepancies in your publication. However, in your issue of May 26, 1958 on page 102, the graph showing the present trends of fossil fuel to the year 1975 seems to be in error in the cost. You have cents per billion BTU's and I think you meant Million BTU's.

These gremlins will creep in every now and then, I know. I enjoy your magazine thoroughly and wish you continued success with it.

C. D. Anderson
Power Sales Engineer
Savannah Electric & Power Co.
Savannah, Ga.

Thanks, Reader Anderson, for putting it so delicately.

Ferroresonance?

To the Editor:

The April 21 Electrical World has an article on page 72 entitled "Operating Nongrounded Wye-Delta Banks" which I would like to question. It is my belief that the phenomenon encountered by the author is ferroresonance.

An overvoltage impressed on one winding of a modern 7.2/12.5-kv transformer will cause a maximum output voltage across the other winding of about 140% of normal because of saturation of the core. Therefore, regardless of what voltage is impressed on the secondary of the transformer in question, the maximum voltage on the primary would be in the order of 10 kv. This voltage would not be enough to cause sparkover of an arrester rated at 9 kv.

Lawrence B. Crann
Electric Engineering Division
Rural Electrification Administration
Washington 25, D. C.

Operation Bootstraps

To the Editor:

Would your group be willing to organize and promote a community-wide "Do-it-ourselves" recovery plan along lines either similar or modified from the plan being used in this area?

This following material will indicate something of the nature of our approach:

Why expect the government to bail us out of our economic troubles? If we have a "free enterprise" economy lets "enterprise" a little *on our own* and see if we can't get things moving properly with *our own* initiative!

The following items may be useful *in whole* or in part depending on your particular industry or business situation. Some of these (and other) ideas have already been tried in various U S communities but *never* on a broad scale community-wide, state-wide or Nation-wide basis:

1. New Construction
   Build *now* that house or building.
2. Repair
   Fix the roof, build an addition, repair appliances.
3. New Equipment
   Aim at a goal of one new piece of household equipment for every employed family within 2 months. For every business or industry a similar goal of new equipment.
4. Prices
   To encourage sales, hold or if possible cut prices.
5. Wages
   Discourage wage or salary increases that might in turn require price increases.
6. Organize ourselves on a community basis to do some, all or *more* of this type of thing *immediately*. Time is of the essence.

R. P. Luse, Manager
Hancock-Wood Electric Co-op
North Baltimore, Ohio

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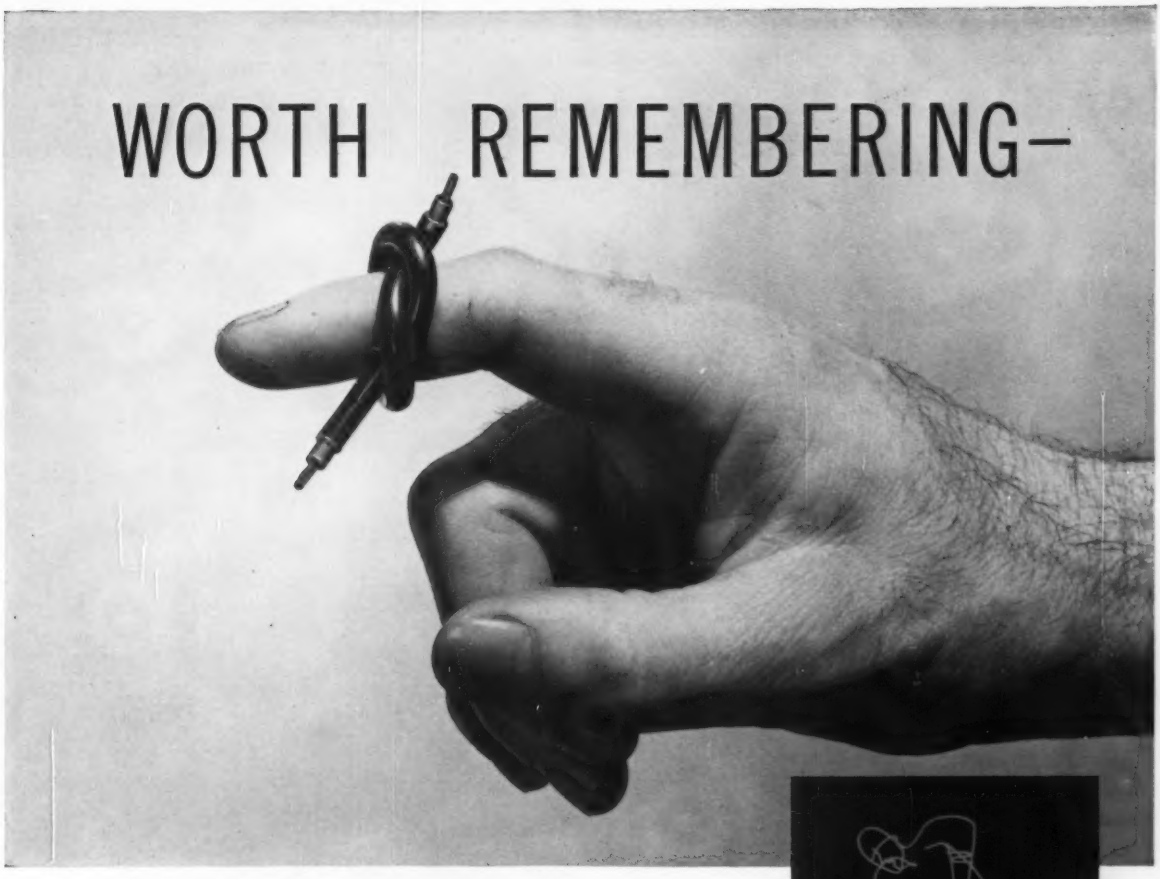

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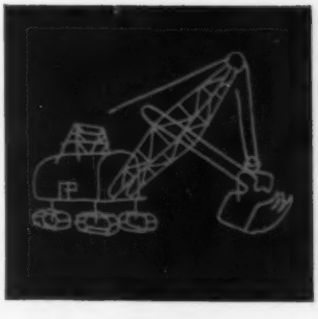

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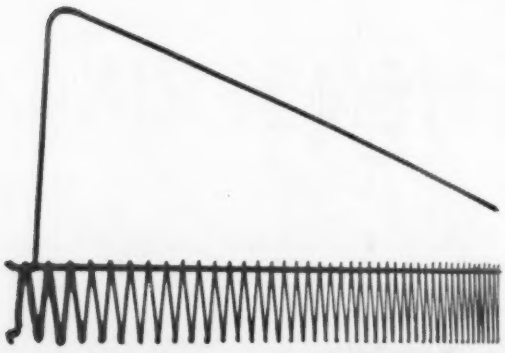

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